ABSTRACTS OF NORTH AMERICAN GEOLOGY

November 1967

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1967

UNITED STATES DEPARTMENT OF THE INTERIOR

STEWART L. UDALL, *Secretary*

GEOLOGICAL SURVEY

William T. Pecora, *Director*

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C. 20402
Price 45 cents (single copy). Subscription price: $5.00 a year (12 monthly issues); $1.25 additional for foreign mailing. Use of funds for printing this publication approved by the Director of the Bureau of the Budget (December 8, 1965). (exp. 12-68)

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INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals, but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with small circulation (such as dissertations, open-file reports or memorandums) or of other papers presented orally at meetings.

The Abstracts is an additional reference tool but does not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology are published each year. The Bibliography includes citations and subject index for a calendar year.

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ABSTRACTS

01608 **Abel, John F., Jr.** Tunnel mechanics: Colorado School Mines Quart., v. 62, no. 2, 88 p., illus., tables, 1967.

The complete description of the mechanical response of a rock mass to a tunnel requires the analysis and interpretation of the controlling geologic and construction conditions. Computer analysis of the set loads, rock strains, geologic conditions, and construction practices at the Straight Creek tunnel pilot bore demonstrates the inelastic controls on tunnel mechanics. Statistical models describe the mechanism of load transfer and rock strain associated with an advancing tunnel face. The time to mass stabilization at Straight Creek is controlled by certain inelastic conditions in the rock mass and by the tunnel advance rate. The set loads at Straight Creek are controlled by the size and placement of the set plus certain inelastic geologic conditions.—Author's abstract

Adams, Ernst S. *See* Walter, Louis S. 01628

01784 **Agapova, G. V.** Nekotoryye cherty geomorfologii severo-zapadnoy chasti atlanticheskogo okeana: Akad. Nauk SSSR Okeanologiya, v. 6, no. 4, p. 666–671, illus., 1966; English translation, Oceanology Acad. Sci. USSR, v. 6, no. 4, p. 545–550, illus., 1966 [1967].

As a result of marine geological investigations in the northwestern Atlantic Ocean in 1963, data were obtained on bottom relief of the continental slope and rise off the northeastern coast of North America and adjacent parts of the Sohm and Hatteras abyssal plains. Precise depth recorders used have yielded detailed data on geomorphological peculiarities of the areas and character of their boundaries. Morphometric characteristics, such as relative depths and heights, slope angles of some relief forms and provinces have been determined. Boundaries between different provinces are indicated either by a distinct replacement of a complex of bottom relief forms or by changes of the bottom surface inclination. Boundaries between slope and rise range within considerable depth limits, while those between abyssal plains and elevations show only slight changes in depth.—*from* Author's abstract

01612 **Agterberg, F. P.; Cameron, G. D.** Computer program for the analysis of multivariate series and eigenvalue routine for asymmetrical matrices: Canada Geol. Survey Paper 67-14, 54 p., illus., tables, 1967.

A computer program is presented by which the transition matrix for a multivariate series can be calculated. The solution is based on the assumption that the series satisfies a Markov scheme of the first order. By means of the eigenvalue routine, the transition matrix is divided into separate components of two types: (1) components consisting of real numbers only, and (2) components consisting of complex numbers. The trend factors extracted from components of the first type indicate linear combinations of the variates with a variation pattern that is close to a smooth curve when the eigenvalue for the component is close to unity. Components of the second type occur in conjugate pairs and may describe cyclical variations of the variates.—Authors' abstract

01841 **Akin, Wallace E.** The geology and soils of Iowa—[Pt. 1] A look at Iowa's geology: Jour. Soil and Water Conserv., v. 22, no. 3, p. 110–112, illus., table, 1967.

The bedrock of Iowa ranges in age from Precambrian to Cretaceous, but Pleistocene deposits account for most of the surface geology. A sketch map shows the distribution of Pleistocene deposits, and stratigraphic units are tabulated. The history of pre-Wisconsin and Wisconsin glaciation is reviewed.—ESL

01897 **Alberta Society Petroleum Geologists.** Oil fields of Alberta supplement, 1966: Calgary, Alberta, Alberta Soc. Petroleum Geologists, 136 p., illus., 1967.

This publication is a supplement to the oil fields of Alberta volume published in 1960. The format, similar to the original, has (1) a category for major fields (with reserves over 1 million bbl) with maps and summaries including geology, development, and production data, and (2) a category for small fields (with reserves between 100,000 and 1 million bbl), each summarized in the appendix. Generally, fields in the original volume were revised if the number of wells on the field increased by approximately 25 percent. A special paper by N. A. Strom summarizing Alberta's proration plan is cited separately.—LLP

01445 **Aley, Thomas J.** Water balance study of Greer Springs, Missouri: Caves and Karst, v. 9, no. 2, p. 12–15, illus., table, 1967.

This study was made in the hope that it will encourage the use of water balances in karst hydrology. Greer Springs lies in a steep valley in predominantly dolomitic Gasconade formation (Ordovician); water emerges from two outlets, the lower under hydrostatic pressure, the upper free flowing. Daily flow measurements since the 1920's and other published data are extensive; the slight surface runoff simplifies the water balance calculation. From comparisons of predicted and actual 1948–53 values, water balance indicates that yearly spring discharge can be predicted with reasonable accuracy. Large discrepancies appear in monthly values. Water balances give insight into some of the physical features of the Greer Springs watershed, such as its areal borders and recharge factors.—GDC

Alfors, J. T. *See* Putman, G. W. 01668

Allen, Clarence R. *See* Brune, James N. 01517

01559 **Allen, Rhesa M., Jr.** Geology and mineral resources of Page County, Virginia: Virginia Div. Mineral Resources Bull. 81, 78 p., illus., table, geol. map, 1967.

Bedrock of Page County in northwestern Virginia is Precambrian to Devonian, with one known occurrence of Triassic igneous rock. Quaternary terrace gravels cover much of the bedrock in the central part, and river flood-plain alluvium is present along the margins of the South Fork and major tributaries. The oldest Precambrian unit is the Pedlar Formation which is essentially granodioritic. Major structures include from east to west: western flank of the Blue Ridge-Catoctin Mountain anticlinorium, faulted and intensely folded anticlinal structure of the central part of the county, and synclinal complex of the Massanutten Mountain area. Mineral resources are gneissic and granitoid rocks and greenstone for construction purposes, carbonate rocks, sand and gravel, quartzose rocks, and clays. Copper, manganese, and iron ores have been mined in the past.—*from* Author's abstract

11114 **Allen, V. T.; Sherman, G. D.** Comparison of bauxite deposits in Oregon and Hawaii, U.S.A. [with French and Croatian abs.]: Com. Internat. Étude Bauxites, Oxydes et Hydroxydes Aluminum Travaux 1966, no. 2, p. 83–98, illus., tables, 1966.

More rapid leaching of silica is suggested from basaltic lavas of Hawaiian volcanoes than from typical plateau basalts in Oregon. Bauxite formation in Hawaii was aided by the presence of low-silica basalts that are higher in alkalis and magnesia, important components of the chemical system including pH which controls the range at which silica and alumina are mobile. More clinker voids provide permeable zones for artesian water. Occurrence of bauxite on the east or northeast sides of Kauai, Maui, and Hawaii is due not only to favorable climate but also to the slope of the lava toward the drier coast. Gibbsite nodules, at various depths, could have been formed by artesian waters leaching silica from basaltic glass along clinker zones. The Oregon plateau basalts have glass in the groundmass, and tuffaceous material in upper part of some flows.—GDC

Alperstein, R. *See* D'Appolonia, E. 01894

01719 **Alt, David.** Pattern of post-Miocene eustatic fluctuation of sea level [abs.], *in* Tertiary sea-level symposium: Coastal Research Notes, v. 2, no. 4, p. 6, 1967.

01754 **Am. Assoc. Petroleum Geologists.** (Pacific Section). Sacramento Valley, Suisun Bay to Lodi, California: Am. Assoc. Petroleum Geologists Pacific Sec. Correlation Sec. 15, 1 sheet, 1967.

01755 **Am. Assoc. Petroleum Geologists.** (Pacific Section). San Andreas fault cross sections—East and west longitudinal cross-sections parallel to the San Andreas fault and east to west cross-sections across the San Andreas fault, California: [Los Angeles, Calif.] Am. Assoc. Petroleum Geologists Pacific Sec., 1 sheet, 1967.

01626 **Amsden, Thomas W.** Chimneyhill limestone sequence (Silurian), Hunton Group, Oklahoma, revised: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 6, pt. 1, p. 942–945, illus., 1967.

The Chimneyhill Formation comprises a sequence of Early and Middle Silurian limestone. It is proposed that it be changed to Chimneyhill Subgroup, and that the Keel, Cochrane, and Clarita members be elevated to formation status. The Ideal Quarry is included as a member of the Keel Formation, and the Clarita Formation is divided into an upper Fitzhugh Member (new) and a lower Prices Falls Member (new).—WCC

11095 **Amstutz, G. C.** Porfidi cupriferi—Geologia, esplorazione, valorizzazione: Italia Servizio Geol. Boll. 1965, v. 86, p. 3–15, illus., 1966.

Porphyry copper deposits are not known in Europe, but there are possibilities that should be explored. The occurrence, origin, and evolution of known deposits are described briefly as a guide to exploration. A scheme of mineralization patterns is diagrammed and used as the basis of the paper. Primary and secondary sulfides and the oxidized zone are discussed and shown in a diagram. Stages of exploration include literature search, conferences after each stage, and the thorough knowledge of the geology necessary to interpret the geochemical and geophysical investigations.—ESL

01878 **Andersen, Neil R.** Observed variations in the strontium concentration of sea water—A letter received [addendum to 1966 paper by E. E. Angino, G. K. Billings, and N. R. Andersen]: Chem. Geology, v. 2, no. 1, p. 77, 1967.

A section of acknowledgements omitted from the paper by E. E. Angino, G. K. Billings, and N. R. Andersen "Observed variations in the strontium concentration of sea water", Chem. Geology, v. 1, no. 2, p. 145–153, 1966, is given.—VSN

01737 **Anderson, A. T.** The dimensions of oxygen isotopic equilibrium attainment during prograde metamorphism: Jour. Geology, v. 75, no. 3, p. 323–332, illus., tables, 1967.

The O^{18}/O^{16} ratio of quartz in metasedimentary detrital rocks and iron formations is related to the modal abundance of quartz or iron oxides in the rocks. The relationship is explained according to a hypothesis of local, closed-system recrystallization of metastable detrital material derived from a high-temperature source mixed with varying proportions of isotopically heavy material (clays, carbonates, and siliceous and ferruginous ooze) in low-temperature isotopic equilibrium with seawater. Oxygen isotopic equilibrium attainment during prograde metamorphism is commonly limited to dimensions less than meters and may generally be limited to dimensions less than centimeters. Small-scale disequilibrium if undetected, can lead to errors in deduced "isotopic temperatures" of the order of 100°C. Such errors can generally be avoided by selecting small, fine-grained, homogeneous samples.—Author's abstract

01813 **Anderson, Duwayne M.** The interface between ice and silicate surfaces: U.S. Army Materiel Command Cold Regions Research and Eng. Lab. Research Rept. 219, 31 p., illus., tables, 1967.

Experiments have been conducted with a particular layer lattice silicate, montmorillonite, in order to study the interaction of water and ice with silicate surfaces. The structural features of this class of silicate minerals are described, and other aspects which have a particular bearing on interfacial phenomena are discussed. Emphasis is placed on the nature of water and aqueous solutions, mechanisms of clay–water interaction, physical and thermodynamic properties of clay–adsorbed water, freezing point depression and supercooling, the existence of unfrozen interfacial water, spatial distribution of unfrozen water, the nature of the ice phase, and phase relationships.—Author's summary

01591 **Anderson, Orson L.** Equation for thermal expansivity in planetary interiors: Jour. Geophys. Research, v. 72, no. 14, p. 3661–3668, illus., tables, 1967.

Using the Murnaghan equation of state, the variation of the coefficient of thermal expansion with specific volume is shown to be $\ln(\alpha/\alpha_o)=\beta_T \ln(V/V_o)$, where β_T is the isothermal derivative of the bulk modulus with pressure, evaluated at zero pressures, and the zero subscripts refer to zero pressure values of the parameters. The above expression has several approximations arising from thermodynamic transformations. An attempt is made to justify these approximations by presenting the laboratory data for α quartz, spinel, garnet, MgO, and Al_2O_3.—Author's abstract

01874 **Aoki, Ken–ichiro.** Petrography and petrochemistry of latest Pliocene olivine–tholeiites of Taos area, northern New Mexico, U.S.A.: Contr. Mineralogy and Petrology, v. 14, no. 3, p. 191–203, illus., tables, 1967.

In north–central New Mexico enormous volumes of basaitic rocks erupted in latest Pliocene time forming large flat plateaus along the western foot of the Rocky Mountains. The volcanic rocks are divided into three series, the lava flows of the middle series accounting for over 95 percent of both area and volume. The first two series are olivine–tholeiites, the third calc–alkaline andesite. Twenty volcanic rocks, five groundmass plagioclases, and five groundmass clinopyroxenes have been chemically analyzed. The basalts, intermediate between tholeiitic and alkaline types, are rather similar to the high–alumina basalt from Oregon and the Cascade Range. Crystallization trends of groundmass plagioclase and clinopyroxene closely resemble those found in Japanese and Kilauean tholeiites.—GDC

Appelt, H. *See* Schalscha, E. B. 01473

01437 **Appleyard, Edward C.** Nepheline gneisses of the Wolfe Belt, Lyndoch Township, Ontario—[Pt.] 1, Structure, stratigraphy, and petrography: Canadian Jour. Earth Sci., v. 4, no. 3, p. 371–395, illus., table, 1967.

The Wolfe Belt is a sequence of banded gneisses characterized by nepheline and other minerals with abnormally high sodium contents. On the north side of the belt are leucocratic feldspathic gneisses with bands of quartzite, crystalline limestone, and amphibolite. The southern half of the belt consists of calc–silicate gneiss with intercalated metamorphic pyroxene and 'iron–formation.' Nepheline may be present in all of the units except the quartzite, but its distribution is irregular. The species and composition of the associated mafic minerals are related to the nepheline content of the rocks as well as to the bulk rock composition. The Wolfe Belt is interpreted as being of metasedimentary origin, the parent rocks having been metasomatized during the Grenville orogenic period.—*from* Author's abstract

11083 **Archbold, N. L.** Industrial mineral deposits of Mineral County, Nevada: Nevada Bur. Mines Rept. 14, 32 p., illus., 1966.

Large reserves of diatomite occur interbedded with Tertiary volcanic rocks at several localities in Mineral County. All known clay deposits are bentonitic. Three saline playas have been worked for halite, sodium carbonate, and boron salts, and brines beneath them have a future potential. Fluorite veins cut Tertiary volcanic rocks in two parts of the county and barite occurs in a belt trending northwesterly across the center. A single deposit of gypsum occurs in the Mesozoic. Andalusite, sillimanite, and corundum form disseminated deposits near Hawthorne. Large reserves of pumice, perlite, building stone, limestone, and sand and gravel have not

been exploited because they are remote. One large body of milky quartz occurs in the Wassuk Range west of Hawthorne.—*from* Author's abstract

01744 **Armstrong, C. A.** Geology and ground water resources, Divide County, North Dakota—Pt. 3, Ground water resources: North Dakota Geol. Survey Bull. 45, pt. 3 (North Dakota Water Conserv. Comm. County Ground Water Studies 6), 56 p., illus., table, 1967.

Ground water in Divide County is obtained from aquifers in glacial drift and in the Paleocene Tongue River Formation. Most productive aquifers consist of buried sand and gravel deposits in the ancestral Yellowstone River channel where well yields of more than 500 gpm are obtainable in places. Yields of more than 500 gpm are available from surficial and buried outwash deposits in the northwestern and southeastern parts of the county. Yields of 50–500 gpm are obtainable from buried sand and gravel deposits in the ancestral Missouri River channel, less permeable deposits in the ancestral Yellowstone channel, and less permeable parts of surficial and buried outwash deposits. Water from glacial drift aquifers ranges greatly in quality; generally it is very hard and of a calcium bicarbonate type. Some water in the Tongue River Formation is too saline for human consumption or irrigation.—*from* Author's abstract

Ashwell, I. Y. *See* Brunger, A. G. 01588

Augelli, John P. *See* West, Robert C. 11094

01787 **Avila, John.** Urbana meets basic oil-bearing criteria: Oil and Gas Jour., v. 65, no. 27, p. 106–110, illus., 1967.

The Urbana oil field was opened July 18, 1966 in northern Indiana. The discovery well produced from a vuggy dolomitic part of the Ordovician Trenton Limestone at a depth of 1,032 feet. Treatment for formation damage was necessary because the Trenton takes up drilling mud. Production was increased in some wells by acid treatment. Urbana oil field is located on the north flank of Kankakee arch in the extreme southwestern flank of the Michigan basin. This area offers a big potential for petroleum exploration in the Trenton; potential traps are wedgeouts in the porous dolomite facies, closed local highs, and faults. It appears that local structures are not as important as porosity and permeability that results from dolomitization.—KAD

01453 **Axelrod, Daniel I.** Drought, diastrophism, and quantum evolution: Evolution, v. 21, no. 2, p. 201–209, illus., 1967.

Restricted areas of greater drought probably were sites for quantum evolution of Cretaceous angiosperms as they radiated polewards from rain forests. With only moderate tectonism and volcanism, local dry sites would appear on lee slopes and in intra-range valleys in 0.5–2.0 million years, and would persist for 10–30 million years before similar conditions spread over the lowlands. Dry areas would have a diversity of potential habitats, be essentially free of competition, cause geographic isolation, and enable new adaptive types to evolve at a rapid rate, leading to quantum evolution. Plants adapted to longer periods of drought probably continued to evolve in local dry sites, sending out waves of new taxa that were more highly adapted to the increasingly drier climates that spread over the lowlands during the Cenozoic.—*from* Author's summary

01425 **Baadsgaard, H.; Godfrey, John D.** Geochronology of the Canadian Shield in northeastern Alberta—[Pt.] 1, Andrew Lake area: Canadian Jour. Earth Sci., v. 4, no. 3, p. 541–563, illus., tables, 1967.

Field work and petrographic investigations of the Precambrian rocks indicate a complex history involving at least three major diastrophic periods; dates determined on samples of major rock units may be placed in three groups roughly corresponding to the periods. All mica K–Ar dates are close to about 1800 m.y., while zircon, uraninite, and allanite U–Pb dates fall into two groups at about 1900 m.y. and 2250 m.y. A whole rock Rb–Sr isochron plot on basement gneiss also yields two groups at about 1900 m.y. and 2250 m.y. The petrographically estimated response

of minerals to sequential geologic events is reflected with good correlation by the various dates determined on the minerals. Some discrepancies in correlation include relatively 'old' zircon in a younger intrusive plug and apparent absence of primary intrusive rocks at the time of the oldest and the youngest diastrophic periods.—*from* Authors' abstract

Back, William. *See* Hanshaw, Bruce B. 01383

01782 **Baffa, John J.; Bartilucci, Nicholas J.** Wastewater reclamation by groundwater recharge on Long Island: Water Pollution Control Federation Jour., v. 39, no. 3, pt. 1, p. 431–445, illus., tables, 1967.

The stratigraphy of the Cretaceous–Quaternary beds under Long Island is reviewed and shown in diagrams. All of the communities in Nassau and Suffolk Counties draw their water from this ground-water reservoir, with a sustained water table under unsewered areas and a falling water table under sewered areas. The availability of waste-water effluents offers a means of supplementing the natural supply and preventing salt-water intrusion, important because the piezometric pressure is only a few feet above sea level. Methods of waste water renovation for various ultimate uses are described. Recharge wells are compared with recharge basins, and preliminary results on the Riverhead, N. Y., injection well research project are given.—ESL

11112 **Bailey, S. W.** (editor). Clays and clay minerals—Proceedings of the 14th national conference, Berkeley, California [1965], conducted by the Clay Minerals Society: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 26), 443 p., illus., tables, 1966.

The papers of three symposiums and a general session are given in this volume. The first symposium is on structure and quantitative analysis, the second on surface reactivity, and the third on genesis and synthesis of clays. Eighteen papers and one abstract are cited individually. (See Abstracts of North American Geology for October 1967.)—GDC

Bailey, William A. *See* Whitman, Robert V. 01895

01745 **Baker, Claud H., Jr.; Paulson, Q. F.** Geology and ground water resources, Richland County, North Dakota—Pt. 3, Ground water resources: North Dakota Geol. Survey Bull. 46, pt. 3 (North Dakota Water Comm. County Ground Water Studies 7), 45 p., illus., table, 1967.

Water supplies in Richland County are obtained mainly from ground water, most important sources being the Sheyenne delta and Hankinson aquifers from shoreline deposits of glacial Lake Agassiz and with a combined area of about 400 square miles; the well-sorted deposits range from 50–100 feet thick. Possible well yields range from 50–1,000 gpm; aquifers are relatively undeveloped and water levels are only a few feet below land surface. The Sheyenne delta aquifer contains an estimated 4 million acre-feet in storage and receives about 50,000 acre-feet of recharge during a year of average precipitation. Water in the two aquifers generally contains less than 500 ppm dissolved solids, and although hard, is usable for most purposes. Aquifers of less importance are associated with till deposits or are in the Dakota Sandstone.—*from* Authors' abstract

01541 **Baker, Victor R.** Hydrology of the cavernous limestones of Schoharie and Albany Counties, New York [abs.], *in* New York State Geol. Assoc., Guide book to field trips, 39th Ann. Mtg., New Paltz, N. Y., 1967: New York, City Coll. City Univ. New York, Dept. Geology, p. TK2, 1967.

01840 **Bancroft, A. M.; Basham, P. W.** An FM magnetic tape recording seismograph: Dominion Observatory Ottawa Pubs., v. 35, no. 4, 217 p., illus., 1967.

A three-component, short period seismograph has been developed in which frequency-modulated magnetic tape is used as the recording medium. The techniques for maintaining a well-calibrated system under field conditions are discussed in detail. Present methods for editing and conversion to a digital format

are also described. The possibilities are explored for a modified system that produces additional long-period information from short-period seismometers.—Authors' abstract

01718 **Bandy, Orville L.** Cycles in Neogene paleo-oceanography and eustatic changes [abs.], *in* Tertiary sea-level symposium: Coastal Research Notes, v. 2, no. 4, p. 4–5, 1967.

01446 **Banta, William C.** A new species of *Neofungella* (Bryozoa, Stenolaemata) from southern California: Southern California Acad. Sci. Bull., v. 66, no. 1, p. 35–38, illus., 1967.

In view of the scattered distributions of the fossil genera, the discovery of a new member of the genus *Neofungella* from California, described here, is of interest. This genus was erected (Borg, 1933) in his revision of recent Heteroporidae, to accomodate an antarctic species which was allied more closely with fossil genera *Multicresis* and *Fungella*.—GDC

01881 **Banwell, C. J.** Geothermal power: Impact of Science on Society, v. 17, no. 2, p. 149–166, tables, 1967.

The success of power and heat production schemes in Italy, Iceland, New Zealand, and California have stimulated an increasing interest in possibilities of geothermal energy. World distribution of hydrothermal fields is discussed; 28 areas with power potential (five in Central and North America) and natural heat flows from nine selected areas are tabulated. Heat discharged in volcanic activity is only a fraction of the heat output of hydrothermal activity which is only one-tenth of the production obtainable by drill holes. Hydrothermal energy is used for electric power generation, as a heat source for a number of processes, including desalination, and for heating houses. The possibility of producing geothermal energy in deep drill holes is discussed.—ESL

Barker, D. A. *See* Feth, J. H. 11066

01496 **Barnes, Robert H.; Wilson, Charles W., Jr.** Geologic map of the Beaverdam Springs quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 41-NE, scale 1:24,000, separate text, 1967.

The accompanying text, "Mineral resources summary of the Beaverdam Springs quadrangle, Tennessee," by L. T. Larson (1967) is cited separately.—MCM

01567 **Barnes, Robert H.; Larson, Lawrence T.; Hershey, Robert E.** Mineral resources summary of the Tharpe quadrangle, Tennessee (including the Tennessee portions of the Model, Rushing Creek, and Hamlin quadrangles, Kentucky-Tennessee): Nashville, Tenn., Tennessee Div. Geology, 15 p., tables, 1967.

This summary accompanies Tennessee Div. Geology Geol. Map GM 28-SW by M. V. Marcher (1967), which is cited separately. Mineral resources mined in the Tharpe quadrangle are iron ore, limestone, chert, sand, and gravel. No mining or systematic prospecting for iron ore has been reported for many years; most deposits are on high hillsides or ridge crests, enclosed in chert, clay and silt residuum, and are small. Possible sources of limestone are the St. Louis, Warsaw, and Fort Payne. Sand and gravel is found in alluvial material, Tuscaloosa Gravel, and Coffee Sand. Three unsuccessful oil and gas test wells have been drilled.—MCM

01583 **Barnes, Steven S.** Minor element composition of ferromanganese nodules: Science, v. 157, no. 3784, p. 63–65, illus., 1967.

Mineralogical and chemical analyses performed on 67 ferromanganese nodules from widely varying locations and depths within the marine environment indicate that the minor-element composition is controlled by the mineralogy, and that the formation of the mineral phases is depth dependent.—Author's abstract

Barnes, Virgil E. *See* Corpus Christi Geological Society. 11067

01402 **Barnett, Stockton Gordon, 3d.** Late Cayugan and Helderbergian stratigraphy of southeastern New York and northern New Jersey [abs.]: Dissert. Abs., Sec. B., Sci. and Eng., v. 27, no. 9, p. 3145B, 1967.

Bartilucci, Nicholas J. *See* Baffa, John J. 01782

Basham, P. W. *See* Bancroft, A. M. 01840

11085 **Bass, Robert C.** Additional Hugoniot data for geologic materials: Sandia Corp. Labs., Albuquerque, N. Mex., Rept. SC-RR-66-548, 29 p., illus., tables, 1966.

Hugoniot equation-of-state data have been obtained for several additional geologic materials. Included are andesite, volcanic breccia, granite, limestone, oil shale, tuff, and alluvium.—Author's abstract

Bastron, Harry. *See* Lee, Donald E. 01659

11058 **Bath, Markus.** Earthquake energy and magnitude, *in* Physics and chemistry of the Earth, V. 7: London and New York, Pergamon Press, p. 117-165, illus., tables, 1966.

The current state of determinations of earthquake energy is reviewed, with emphasis on methods and principles rather than on results of determinations. The problem of energy calculation can be approached either from field observations in the epicentral area or from seismograms, both in combination with theoretical studies; the seismogram method is treated in more detail in this paper. Notation systems, basic formulas for strain energy, spherical and dislocation sources in a perfectly elastic solid, a spherical source in a non-elastic solid, body- and surface-wave energy from seismograms, basic principles of magnitudes, numerical evaluation of magnitude and energy, and application of the energy concept in seismological studies are discussed. A list of about 120 references is included.—VSN

11080 **Bauer, A.** Le bilan de masse de l'Indlandsis du Groenland n'est pas positif [with English, German, and Spanish abs.]: Houille Blanche, v. 21, no. 7, p. 802, 822, 832-836, illus., 1966.

According to calculations by H. Bader (1961), the mass budget for the Greenland Icecap is positive. However, a more recent calculation by Bauer (1966), based on observations during the Expédition Glaciologique Internationale au Groenland in 1957-58, and also in 1964, indicates a negative mass budget of -110 km^3 per year equivalent value in water, which would represent an uniform rise in sea level of 0.3 mm per year. Calculations from other recent observations give values of the same order of magnitude.—VMJ

Bé, Allan W. H. *See* McIntyre, Andrew. 01843

Beck, Charles B. *See* Pettitt, John M. 01704

01827 **Beebe, B. Warren.** Quest for unity in the geological sciences: Geotimes, v. 12, no. 5, p. 18-20, 22, illus., 1967.

The continuous splintering in the history of geology, and attempts to form one all-inclusive organization for members of the profession are described, with emphasis on the speeches of Carey Croneis. In 1944, a constitutional convention was held with eight societies represented, objectives were outlined, and a constitution approved. Finally in 1948 the first meeting of the American Geological Institute was held and officers elected. This paper is the first in a series on the history of the AGI.—ESL

01811 **Behrendt, Ernst.** Earth: Garden City, N. Y., Nelson Doubleday, Inc. (Science Service, Science Program Series), 64 p., illus., 1967.

This popular account of the Earth's history and processes includes discussions of the age and origin of the Earth and the solar system, the Earth's interior, magnetic

field, volcanoes, earthquakes, glaciation, formation of mountains, and continents.—LLP

11113 **Behrendt, Ernst.** Oceans: Garden City, N. Y., Nelson Doubleday, Inc. (Science Service, Science Program Series), 64 p., illus., 1966.

This is a popular account of the oceans of the world including sections on the continental shelves, submarine trenches, currents, waves, tsunamis, tides, ocean depths, and ocean bottom.—LLP

Beiser, Arthur. *See* Krauskopf, Konrad. 11069

01727 **Béland, René.** Les failles rotationnelles et la projection stéréographique: Naturaliste Canadien, v. 94, no. 4, p. 161–162, illus., 1967.

Stereographic projection is a simple and rapid method of finding the possible positions of rotational faults which can account for observed discontinuities in geologic structure planes. There are an infinite number of possible fractures, but certain geometric restrictions limit what the stereographic projection can depict clearly and rapidly. Illustrated examples are presented.—GDC

01614 **Belyea, H. R.; Norford, B. S.** The Devonian Cedared and Harrogate Formations in the Beaverfoot, Brisco, and Stanford Ranges, southeast British Columbia [with French abs.]: Canada Geol. Survey Bull. 146, 64 p., illus., tables, 1967.

The Harrogate Formation is redescribed and includes less strata than assigned to the formation by Evans (1933). The fauna indicates Givetian (Middle Devonian) age. The Cedared Formation is proposed for beds placed in the lower part of the Harrogate Formation and in the upper part of the Beaverfoot–Brisco Formation by Evans (1933). Charophytes suggest Middle Devonian age. The Cedared paraconformably overlies Lower Silurian rocks in most outcrops, and is laterally equivalent to the evaporitic Burnais Formation. The sedimentary petrography and diagenetic changes of rocks of the Cedared Formation are described in detail; it is thought to have accumulated in a gently subsiding basin whose upper surface was lime mudflats covered by shallow water. The Cedared, Burnais, and Harrogate Formations correlate with parts of the Elk Point Group of Alberta.—*from* Authors' abstract

01459 **Bendix-Almgreen, Svend Erik.** On the fin-structure of the upper Permian edestids from East Greenland: Dansk Geol. Foren. Medd., v. 17, no. 1, p. 147–149, illus., 1967.

Well-preserved remains of the edestid elasmobranch *Fadenia crenulata* from upper Permian marine beds of East Greenland were mentioned in an abstract by the author (ibid., v. 15, no. 1, 1962). The pectoral fin material has been studied further, and suggestions are made concerning the musculature and nerve supply. An attempted restoration of the scapulo-coracoid and pectoral fin is shown in lateral view. It is evident that the fin comprises a thoracic and an abdominal division, as in many arthrodires and Recent batoids (rays and skates).—VMJ

Benninghoff, William S. *See* Ray, Clayton E. 01710

11086 **Benson, Richard H.** Recent marine podocopid ostracodes, *in* Oceanography and marine biology—An annual review, V. 4 (H. Barnes, editor): New York, Hafner Publishing Co., p. 213–232, illus., 1966.

The nature and significance of the paleontologically important living ostracodes are presented, and important aspects of ostracode anatomy are summarized. Of the more than 1,000 known genera, about 10 percent are represented by living species; more than 1,000 species of Podocopida are known from the Cretaceous, and most of the living families are represented among these. The study of podocopids over the past 100 years shows five significant steps in the early years, and a second surge of activity from about 1930 to the present. A description of the current status includes the size of the task of the systematist, a measure of efforts toward

exploration, and tracing of development and application of new ideas and theories. An account is given of the Naples symposium on Recent ostracodes.—ESL

Bermúdez, Pedro J. *See* Seiglie, George A. 11107

01815 **Bernhard, Rudolf K.** Stress and wave patterns in soils subjected to dynamic loads: U.S. Army Materiel Command Cold Regions Research and Eng. Lab. Research Rept. 120, 52 p., illus., tables, 1967.

This report is divided into four parts, the first two covering investigations of the reliability of shear stress measurements in soils subjected to vibratory loads for biaxial and triaxial systems, respectively (part 1 in summary only). Part 3 is a study of the three-dimensional "principal" stress patterns produced, and part 4 is a theoretical analysis of some aspects of soil wave propagation in stratified soil. The stress distribution of a triaxial system can be determined by measurement of five shear stresses and one normal stress. In noncohesive soils the triaxial stress fields can be determined by recording six independent stress components. Sinusoidal force excitation and impact excitation yield time-distance graphs which can be used to determine reflection and refraction techniques in stratified soils.—GDC

11081 **Berrangé, Jevan P.** Some critical differences between orogenic-plutonic and gravity-stratified anorthosites [with German, French, and Russian abs.]: Geol. Rundschau, v. 55, no. 3, p. 617-642, table, 1966.

A comparison of plutons containing anorthosite as a major or minor constituent, in North America, West Greenland, and elsewhere, shows two essentially different environments: "Orogenic-plutonic anorthosites" are temporally and spatially related to orogeny and belong to the plutonic class of rocks; "gravity-stratified anorthosites" developed under stable cratogenic conditions and belong to the volcanic class. Environment, age, form, internal structures, textures, mineral composition, gravity fields, associated salic rocks, and contact effects are compared. A continuous anorthosite series, analogous to the granite series, is proposed for orogenic-plutonic anorthosites; it includes anorthosite plutons that superficially resemble but genetically differ from the true gravity-stratified anorthosites.—*from* Author's abstract

Bhalla, Braham D. *See* Tek, M. Rasin. 11115

11098 **Bieri, Rudolf H.; Dymond, Jack D.; Koide, Minoru.** A high temperature ultra high vacuum furnace for gas extraction from geologic samples: Earth and Planetary Sci. Letters, v. 1, no. 6, p. 395-396, illus., 1966.

A furnace for extraction of gases from small (tens of milligrams) samples of fine-grained minerals is described and illustrated. The design of the furnace solves the problem of the tendency of grains to "take off" at a critical temperature. It accomodates several samples at a time for successive degassing without breaking vacuum, has a low level of contamination and a very uniform temperature over the whole sample volume, readily attains temperatures above 2,000°C, lacks ionic pumping, and can be constructed at low cost from easily obtainable materials.—VSN

01451 **Birkelund, Tove.** Submicroscopic shell structures in early growth-stages of Maastrichtian ammonites (*Saghalinites* and *Scaphites*)—A preliminary note: Dansk Geol. Foren. Medd., v. 17, no. 1, p. 95-101, illus., 1967.

The lytoceratid ammonoids *Saghalinites wrighti* Birkelund and *Scaphites (Discoscaphites)* sp. occur in great numbers in an Upper Cretaceous conglomerate in Nugssuaq, West Greenland. Well-preserved shell structures of the early whorls were investigated by electron microscope. The protoconch is composed of a thin porcellaneous layer; this is gradually replaced by another porcellaneous layer. At the constriction about one volution from the apex a prominent nacreous layer gradually appears and the porcellaneous layer of the first whorl wedges out; the nacreous layer wedges out and the porcellaneous and nacreous layers of the second and later whorls appear. The changes of structure at the constriction between the

second and third ontogenetic phases in these species accentuate the difference in ammonoid and nautiloid development.—VMJ

Bjorklund, L. J. *See* Carpenter, C. H. 01810

01575 **Blackadar, R. G.** Geology of Mingo Lake–Macdonald Island map-area, Baffin Island, District of Franklin [with French abs.]: Canada Geol. Survey Mem. 345, 54 p., illus., tables, geol. map, 1967.

Interest in iron deposits of possible economic importance was aroused following reconnaissance geological studies in southern Baffin Island and more detailed geological examination was made. The rocks are mainly Precambrian, and a K–Ar age determination (1,700 m.y.) indicates an early Proterozoic age for the metamorphism. They are lithologically like rocks of the Grenville Province and comprise an assemblage of granulite, granitic gneiss, *lit-par-lit* gneiss, pyroxene-hornblende gneiss, rusty graphite schist and gneiss, and crystalline limestone. Iron deposits are commonly associated with pyroxene-hornblende gneiss. Exploratory work indicated that the iron deposits are not of ore grade under present economic conditions.—*from* Author's abstract

01598 **Blackadar, R. G.** Geology, Mingo Lake–Macdonald Island, Baffin Island, District of Franklin: Canada Geol. Survey Map 1185A (also in Mem. 345), scale 1:253,440, 1967.

01544 **Blackburn, Charles E.** Structure and metamorphism of Huronian rocks at Espanola, Ontario [abs.], *in* New York State Geol. Assoc., Guide book to field trips, 39th Ann. Mtg., New Paltz, N. Y., 1967: New York, City Coll. City Univ. New York, Dept. Geology, p. TK4, 1967.

Blanchard, Laurie R. *See* Stanley, Daniel J. 01829

01713 **Bluemle, John P.** Preglacial topography and drainage in part of northeast North Dakota, *in* Glacial geology of the Missouri Coteau—Midwest Friends of the Pleistocene, Field Conf. 1967, Guidebook: North Dakota Geol. Survey Misc. Ser. 30, p. 131–132, illus., 1967.

In order to determine accurately the preglacial routes of the Knife and Cannonball Rivers, more data are needed. Since regional preglacial drainage was northward to Hudson Bay, the Knife and Cannonball Valleys probably trended northward. There is evidence that the preglacial Cannonnball Valley may have continued through Benson, Ramsey, and Towner Counties into Manitoba, where the regional slope of the bedrock is northward.—LLP

01714 **Bluemle, John P.** Multiple drifts in northeast North Dakota, *in* Glacial geology of the Missouri Coteau—Midwest Friends of the Pleistocene, Field Conf. 1967, Guidebook: North Dakota Geol. Survey Misc. Ser. 30, p. 133–136, illus., 1967.

Exposures of two or more tills are usually found in thin glacial drifts near bedrock outcrops. The tills are often separated by outwash, boulder pavements, erosion surfaces, or soil profiles. The lower tills tend to be harder, more compact, and more strongly jointed than the upper tills. Although the ages are not known, some of the lower tills are believed to be pre-Wisconsinan.—LLP

01404 **Boettcher, Arthur Lee.** The Rainy Creek igneous complex near Libby, Montana [abs.]: Dissert. Abs., Sec. B., Sci. and Eng., v. 27, no. 9, p. 3145B–3146B, 1967.

01837 **Bowen, Zeddie Paul.** Brachiopoda of the Keyser Limestone (Silurian–Devonian) of Maryland and adjacent areas: Geol. Soc. America Mem. 102, 103 p., illus., tables, 1967.

Brachiopod fauna of the Keyser Limestone within a 50-mile radius of the type section at Keyser, W. Va., is described. Six of the 33 species recognized are new: *Rhynchospirina martinensis and R. newcreekensis, Delthyris hyndmanensis, Nanothyris boucoti, Rhynchotreta? hancockensis, and Machaeraria whittingtoni.* New Creek Limestone is a new name proposed for the Coeyman's Limestone unit. Two faunal

zones of the Keyser are redescribed; the name *Meristella praenuntia* Zone is proposed to replace *Favosites helderbergiae praecedens* Zone. On the basis of brachiopods, the *E. jerseyensis* Zone is correlated with the Decker Formation in New Jersey and Rondout Formation and Cobleskill Limestone in New York. The Silurian-Devonian boundary is concluded to lie near the faunal and lithologic gradation within the Keyser Limestone.—*from* Author's abstract

01618 **Boyd, Don R.** Lucille Field, Live Oak County, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 119-123, illus., tables, 1967.

01395 **Boyles, James McGregor.** Zoogeography of the herpetofauna of central Florida [abs.]: Dissert. Abs., Sec. B., Sci. and Eng., v. 27, no. 9, p. 3333B-3334B, 1967.

Bradshaw, John S. *See* Phleger, Fred B. 01832

01654 **Bredehoeft, John D.** Response of well-aquifer systems to earth tides: Jour. Geophys. Research, v. 72, no. 12, p. 3075-3087, illus., table, 1967.

Wells that respond to earthquakes usually respond to earth tides. Because dilatation produced by earth tide Δ_t is about 1×10^{-8} and earth tides in wells often have magnitudes of 1-2 cm, a direct measure of sensitivity of the well-aquifer system is available. With a sensitive measuring device it should be possible to observe dilatations of the Earth of the order of 1×10^{-9}. Thus an artesian well is as sensitive to dilatation as the strain seismometer. Analyses of water level fluctuations caused by earth tides can be used to compute the specific storage and the porosity of the aquifer.—DBV

01599 **Brett, Robin; Higgins, G. T.** Cliftonite in meteorites: Science, v. 156, no. 3776, p. 819-820, illus., 1967.

Cliftonite, a polycrystalline aggregate of graphite with cubic morphology, is known in 10 meteorites. Some workers have considered it to be a pseudomorph after diamond, and have used the proposed diamond ancestry as evidence of a meteoritic parent body of at least lunar dimensions. We have synthesized cliftonite in Fe-Ni-C alloys in vacuum, as a product of decomposition of cohenite [$(Fe,Ni)_3C$]. We therefore suggest that a high pressure origin is unnecessary for meteorites which contain cliftonite, and that these meteorites were formed at low pressures. This conclusion is in agreement with other recent evidence.—Authors' abstract

Bright, Robert C. *See* McAndrews, John H. 01739

Bromery, R. W. *See* U.S. Geological Survey. 01849

Brookins, Douglas G. *See* Rosa, Felipe. 11101

11102 **Brookins, Douglas G.; Twiss, Page C.** A new meteorite find from Buchanan County, Missouri: Kansas Acad. Sci. Trans., v. 69, no. 2, p. 157, table, 1966.

Two new meteorites recently found in Buchanan County are olivine bronzite chondrites, with similar surface conditions, degree of weathering, and mineralogy. They are probably fragments of the same fall and the name Faucett will be applied to both. Further research is intended.—ESL

01807 **Brooks, David B.** The lead-zinc anomaly: Soc. Mining Engineers Trans., v. 238, no. 2, p. 129-136, illus., 1967.

Identified potential resources of lead and zinc are lower, relative to reserves, than the same ratio for other metals. In reviewing arguments for and against this anomaly, the author concludes that it probably derives from a gap in the data rather than in the natural environment, and suggests that low-grade deposits may exist in entirely different areas with little or no apparent relationship to existing districts. These disseminated deposits may be the future source of lead and zinc, as the porphyries are for copper.—ESL

01716 **Brophy, John A.** Some aspects of the geological deposits of the south end of the Lake Agassiz basin, *in* Glacial geology of the Missouri Coteau—Midwest Friends of the Pleistocene, Field Conf. 1967, Guidebook: North Dakota Geol. Survey Misc. Ser. 30, p. 159–165, illus., 1967.

A study of the stratigraphic relationships of the Lake Agassiz delta area has resulted in the following historical interpretation: A proglacial lake was ponded between a late-Wisconsin ice front on the north and high ground to the south. When the ice retreated, the southern Lake Agassiz basin again accumulated lake-water and the Sheyenne River deposited a delta. During the Campbell I phase, the delta was trenched by the Sheyenne River and steepened by wave action. The waters of Lake Agassiz II rose and invaded the trench; when they fell again, the Sheyenne River cut downward adjusting to the new base level and removing much of the Agassiz II fill. In post-Agassiz time, at least one aggradational episode has occurred.—LLP

Brott, Clark W. *See* Rogers, Malcolm J. 11093

01688 **Brower, James C.** The actinocrinitid genera *Abactinocrinus, Aacocrinus* and *Blairocrinus*: Jour. Paleontology, v. 41, no. 3, p. 675–705, illus., tables, 1967.

Actinocrinitidae [Lower Mississippian] can be subdivided into four basic groups, each characterized by common morphology and evolutionary trends. Comparative morphology indicates they are derived from Periechocrinitidae as postulated by Moore and Laudon in 1943. *Abactinocrinus, Aacocrinus, Blairocrinus* are systematically reviewed. *Abactinocrinus* [Kinderhookian, Montana] is believed to lie close to the ancestral stock of the other two genera. Common features of dorsal cup, tegmen morphology and similarities in variation denote *Blairocrinus and Aacocrinus* [Kinderhookian, lower Osagian, Missouri] are closely related; the blairocrinid root stock can be found in *Aacocrinus*. Three new species are described: *Aacocrinus protuberoarmatus, A. triarmatus and A. tetradactylus.—from* Author's abstract

Brown, R. J. *See* Feth, J. H. 11066

01517 **Brune, James N.; Allen, Clarence R.** A micro-earthquake survey of the San Andreas fault system in southern California: Seismol. Soc. America Bull., v. 57, no. 2, p. 277–296, illus., table, 1967.

Observed microearthquake ($M \leq 3$) activity along the San Andreas fault system varies from virtually nil (central section) to more than 75 shocks daily (Imperial Valley). Existence of an area of minimal microearthquake activity (the very segment that broke in the 1857 earthquake) within a broad region of active tectonism suggests that short-term microearthquake activity is not necessarily positively correlated with long-term activity (and earthquake hazard); in some areas the relationship may even be inverse. However, in many areas microearthquake activity can be approximately predicted by extrapolation of 29-year recurrence curves based solely on larger earthquakes.—DBV

01588 **Brunger, A. G.; Nelson, J. G.; Ashwell, I. Y.** Recession of the Hector and Peyto Glaciers—Further studies in the Drummond Glacier, Red Deer Valley area, Alberta [with French abs.]: Canadian Geographer, v. 11, no. 1, p. 35–48, 65, illus., table, 1967.

Estimates of recession are based on photographs, tree-ring data, and recent measurements. Study of the Hector Glacier was confined to the westernmost of several tongues; the photographic record on Peyto is much more complete. Recession of both glaciers is shown in diagrams, and, with the Drummond, in a table. All the glaciers have exhibited continuous recession, increasing until 1930–1940, then decreasing until the present. The time-lag involved in correlating recession with climatic conditions is discussed:—ESL

01902 **Bruun, Per M.** By-passing and back-passing with reference to Florida: Am. Soc. Civil Engineers Proc., v. 93, paper 5243, Jour. Waterways and Harbors Div., no. WW 2, p. 101–128, illus., tables, reprinted 1967; originally published 1966.

This paper was published originally *in* Coastal engineering, Santa Barbara Specialty Conf. 1965, by American Society of Civil Engineers, 1966. (*See* Abstracts of North American Geology for August 1967.)—LLP

Bryant, Luther F. *See* Horton, Wayne C. 01502

Brydon, J. E. *See* Kodama, H. 01673

01500 **Buie, Jeff C.; Gordon, J. E.** Arnold-David Chapman Field, Nueces County, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 16–21, illus., tables, 1967.

Buol, S. W. *See* Qashu, H. K. 01397

01438 **Burger, D.** Distribution and origin of parent soil materials in part of the Ottawa and Bonnechere River valleys, Ontario: Canadian Jour. Earth Sci., v. 4, no. 3, p. 397–411, illus., tables, 1967.

In an area of about 1,500 sq mi, ten parent material classes were recognized on the basis of texture (grain-size) and petrography. . . . The distribution of materials in various landforms was related to mode, direction, and distance of transport from their bedrock sources by glaciation and by subsequent inundation by the post-glacial Champlain Sea. An ancient shoreline in the Ottawa Valley at 500 to 520 feet probably marks an important stage of the Champlain Sea. An improved basis for mapping soil series comes from such an understanding of the geologic events responsible for the distribution of parent materials.—Author's abstract

01624 **Burke, J. D.** Johns Field, Duval County, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 80–85, illus., tables, 1967.

01474 **Burke, Kevin.** The Yallahs Basin—A sedimentary basin southeast of Kingston, Jamaica: Marine Geology, v. 5, no. 1, p. 45–60, illus., 1967.

The Yallahs Basin lying at a depth of 1,300 m is about 100 km^2 in area and contains approximately 500 m of sediments. It is structurally controlled and probably fault bounded. It has been filled by resedimentation of noncarbonate material from two gravel fan deltas and, to a lesser extent, by carbonate from the Jamaican island shelf. After the basin was filled slides and turbidity currents from the more active of the two deltas cut the Yallahs Canyon down some 200 m and back 16 km across the basin. Seismic profiling shows that two series of sediments occur in the basin, one before the canyon was cut and one after. A short core from the upper series shows a well-graded sequence of sands and silts. Cable breaks indicate that the three main sediment sources are still active.—Author's abstract

01611 **Burnette, C. R.** Davy Field, Karnes County, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 50–54, illus., tables, 1967.

Burt, D. M. *See* Hargraves, R. B. 01436

Burt, D. M. *See* Rosenberg, P. E. 01671

Butkovich, T. R. *See* Higgins, G. H. 01532

01557 **Buttner, Peter J. R.** Continental sequences in the proximal Genesee Group (Stop 3, Field Trip C), *in* New York State Geol. Assoc., Guide book to field trips, 39th Ann. Mtg., New Paltz, N. Y., 1967: New York, City Coll. City Univ. New York, Dept. Geology, p. C24–C29, illus., 1967.

The Devonian strata in New York are comprised of various sedimentary types and stratigraphic patterns, but are generally wedge-like in form, thinning to the southwest. The results of a six-year study in southeastern New York indicate that the lower Upper Devonian was produced by a series of fluvial events, and

demonstrate the value of computer techniques for solving stratigraphic problems.—LLP

Buturla, Frank, Jr. *See* Kelley, T. E. 01650

01865 **Byerlee, James D.** Frictional characteristics of granite under high confining pressure: Jour. Geophys. Research, v. 72, no. 14, p. 3639–3648, illus., 1967.

An investigation was made to examine the effects of roughness and confining pressure on the coefficient of friction (μ) and the physical processes involved in frictional sliding of a typical silicate, the Westerly granite. Additional experiments were designed to test the Coulomb criterion of rock fracture, Orowan's theory for the apparent ductility of rocks, and the effective stress theory as applied to friction. The results suggest that stick–slip along a pre-existing fault may be a source of crustal earthquakes. The Coulomb theory does not hold for this granite, while the effective stress theory holds under certain conditions.—DBV

01863 **Byrne, John V.; Kulm, LaVerne D.** Natural indicators of estuarine sediment movement: Am. Soc. Civil Engineers Proc., v. 93, paper 5220, Jour. Waterways and Harbors Div., no. WW 2, p. 181–194, illus., tables, 1967.

Natural sediment indicators are used in Yaquima Bay, Oreg., to show that marine sands enter the bay and move six miles up the estuary. Sediment texture and composition indicate that marine sands from adjacent ocean beaches and nearshore areas are transported into the estuary by strong tidal currents or by wind. The amount of material transported up the estuarine channel decreases according to the decreasing flood current velocities. The extent, magnitude, and rate of deposition within and adjacent to the estuary are influenced by: direction of littoral drift, river runoff, type of estuarine system, and wind direction. These factors dictate that maximum transportation and deposition of sediments occur during the winter and spring.—*from* Authors' abstract

01471 **California Dept. Water Resources.** Hydrologic data, 1965—V. 5, Southern California, App. C, Ground water measurements: California Dept. Water Resources Bull. 130–65, v. 5, 477 p., illus., tables, 1967.

Appendix C tabulates ground water measurements taken in the Central Coastal, Los Angeles, Lahontan, Colorado River Basin, Santa Ana, and San Diego Drainage Provinces from July 1, 1964, through June 30, 1965. The tabulations list water surface elevations at wells, along with state well numbers, ground surface elevation at wells, depth to water from ground surface, date of measurement, and name of agency supplying the data. Recharge activities for the 1964–65 water year are given. Foldout maps depict drainage provinces, boundaries of hydrologic areas, and areas of water-bearing sediments.—Author's abstract

Callender, Edward. *See* Royse, Chester F. 01637

01738 **Callender, Edward.** A preliminary report on the postglacial sedimentology of Devils Lake, North Dakota, *in* Glacial geology of the Missouri Coteau—Midwest Friends of the Pleistocene, Field Conf. 1967, Guidebook: North Dakota Geol. Survey Misc. Ser. 30, p. 137–149, illus., 1967.

Devils Lake in northeastern North Dakota is part of a chain of waterways in the Devils Lake drainage basin. Sediment cores were analyzed for water content, texture, carbonate content, organic carbon, and Ca/Mg, Ca/Fe, and C/N ratios. A preliminary interpretation of the sediment data is that the post-glacial lake was a deeper oligotrophic lake from about 7000 to 4000 yr B. P., and became a shallower eutrophic lake around 3500 yr B. P.—LLP

Cameron, G. D. *See* Agterberg, F. P. 01612

Campbell, K. S. W. *See* Whittington, H. B. 01443

01485 **Canada Geological Survey.** Aeromagnetic map, Sheet 53 G/13, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3689, scale 1:63,360, 1967.

01752 **Canada Geological Survey.** Aeromagnetic map, Igelstrom Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3690, scale 1:63,360, 1967.

Carlson, V. *See* Lennox, D. H. 01676

01810 **Carpenter, C. H.; Robinson, G. B., Jr.; Bjorklund, L. J.** Ground-water conditions and geologic reconnaissance in the upper Sevier River basin, Utah: U.S. Geol. Survey Water-Supply Paper 1836, 88 p., illus., tables, geol. map, 1967.

The upper Sevier River, an area of high plateaus and valleys in south-central Utah, was investigated to determine the general ground-water conditions, interrelation of ground and surface water, effects of increased ground-water pumpage, and amount of ground water in storage. The Panguitch, Circle, East Fork, and Grass Valleys are separate ground-water basins, with surrounding plateaus of Triassic to Quaternary sedimentary and igneous rocks. About a million acre-feet of ground water is stored in the upper 200 feet of valley fill; the basin is recharged principally by infiltration from streams, canals, and irrigation fields. Increased water pumpage would increase recharge to aquifers from the surface water and/or decrease discharge from streams, springs, flowing wells, and phreatophytes areas.—LLP

01732 **Carroll, Roderick D.** Rock properties interpreted from sonic velocity logs—Closure [to 1966 discussion by B. Mather of paper 4715, 1966]: Am. Soc. Civil Engineers Proc., v. 93, paper 5215, Jour. Soil Mechanics and Found. Div., no. SM 3, p. 162, 1967.

In reply to Mather (ibid., v. 92, no. SM 6, p. 254–255, 1966), velocity squared values could not be used because the *in situ* compressional wave velocities are related to laboratory determined static Young's moduli. (See original paper, ibid., v. 92, no. SM 2, p. 43–51, 1966.)—LLP

01708 **Carter, John L.** An unusual spiriferacean brachiopod from the Barnett Formation (Mississippian) of central Texas: Jour. Paleontology, v. 41, no. 3, p. 587–594, illus., table, 1967.

Perissothyris, a new spiriferacean genus based on a new species, *P. masonensis*, from the upper Barnett Formation of the Llano region of central Texas, is described. Interpretation of the unusual external and internal morphology of this brachiopod suggests that it was highly specialized and adapted for survival in a crinoid debris habitat.—Author's abstract

01507 **Carter, Paul H.** South Campana Field, McMullen County, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 188–192, illus., tables, 1967.

01871 **Case, Gerard R.** Fossil shark and fish remains of North America: New York, Grafco Press, 20 p., illus., 1967.

This booklet is comprised mainly of illustrations and identifications of the many types of fossil shark and fish material. Also included are nomenclature of the illustrated species and short sections on Triassic fresh-water fishes, fossil localities, and collecting techniques.—LLP

Chakravarti, Diptiman. *See* Joyner, Timothy. 01862

Chamberlain, John A., Jr. *See* Raup, David M. 01707

Chance, Genie. *See* Hansen, Wallace R. 11108

01641 **Chapman, D. R.; Gault, D. E.** Reply to S. C. Lin's rebuttal [to criticism of "Cometary impact and the origin of tektites", 1967]: Jour. Geophys. Research, v. 72, no. 14, p. 3736–3737, 1967.

Lin's reversion (ibid., v. 72, p. 2700–2703, 1967) to an alternate hypothesis—direct splash—not mentioned in his original paper (ibid., v. 71, p. 2427–2437, 1966) does not serve to support his two mechanisms of tektite origin—blast wave propulsion and vapor condensation—criticized by Chapman and Gault (ibid., v. 72, p. 2695–2699, 1967). To his hypothesis of offshore impact, objections relative to (1) coesite, (2) angle of atmosphere entry, and (3) disruption of drops all apply; (2) and (3) also apply to his hypothesis of land impact; and where on land is the australite age crater scar more than 300 km across?—DBV

01405 **Chaudhuri, Sambhudas.** The geochronology of the Keweenawan rocks of Michigan and the origin of the copper deposits [abs.]: Dissert. Abs., Sec. B., Sci. and Eng., v. 27, no. 9, p. 3146B, 1967.

01669 **Chayes, Felix.** Modal composition of USGS reference sample G–2: Geochim. et Cosmochim. Acta, v. 31, no. 3, p. 463–464, table, 1967.

The modal composition of reference sample G–2 (Bradford granite) is reported and compared with that of G–1 (Westerly granite). There are significant differences in quartz, K–feldspar, plagioclase, and biotite. The possibility of error due to internal variability of the new specimen is assessed.—DBV

Cheetham, Alan H. *See* Schlee, John. 01462

01515 **Chinnery, Michael A.; Toksöz, M. Nafi.** P–wave velocities in the mantle below 700 km: Seismol. Soc. America Bull., v. 57, no. 2, p. 199–226, illus., table, 1967.

The slope of the traveltime curve has been measured on 167 events in the distance range 27°–90° along an azimuth of 300°–320° from the LASA array in Montana. Only a first–order correction of +0.05 sec per degree is found to be necessary. The resulting graph of $dT/d\Delta$ versus Δ is shown to be consistent with other traveltime and amplitude observations. Using an assumed crust and upper mantle structure, a velocity–depth model for the mantle is found which agrees, within the scatter of the data, with both the $dT/d\Delta$ observation and LONGSHOT residuals; it shows three anomalous regions, at depths of 800, 1,300, and 2,000 km, where velocity changes very slowly (and might even decrease) with depth.—DBV

01660 **Christ, C. L.; Truesdell, A. H.; Erd, Richard C.** Borate mineral assemblages in the system Na_2O–CaO–MgO–B_2O_3–H_2O: Geochim. et Cosmochim. Acta, v. 31, no. 3, p. 313–337, illus., table, 1967.

The significant known hydrated borate mineral assemblages in the system Na_2O–CaO–MgO–B_2O_3–H_2O are expressible in three ternary composition diagrams. Phase rule interpretation of the diagrams is consistent with observations, if the activity of H_2O is considered to be determined by the geologic environment. Schematic Gibbs free energy composition diagrams based on known solubility–temperature relationships are useful in interpreting and predicting stability relationships in the $Na_2B_4O_7$–H_2O and $Na_2B_2O_7$–NaCl–H_2O systems. Schematic diagrams expressing the chemical relationships among the mineral assemblages permit the tracing of paragenetic sequences as a function of changing cation and H_2O activities.—DBV

Christie, K. W. *See* Schwarz, E. J. 01465

01613 **Christie, R. L.** Reconnaissance of the surficial geology of northeastern Ellesmere Island, Arctic Archipelago [with French abs.]: Canada Geol. Survey Bull. 138, 50 p., illus., table, geol. map, 1967.

Glacial features and deposits such as erratics, grooves, and till are abundant in northeastern Ellesmere Island. Distinctive erratics and striae indicate a general outward movement of ice from the high mountains of the island with a limited incursion of Greenland ice onto the eastern shores. Glacio–fluvial gravel and sand is widespread, and certain enigmatic 'boulder gravel hills' may be related. Thick

marine and lacustrine silt deposits form conspicuous benches and badlands. A post-glacial marine inundation of at least 250 feet is indicated by marine shells. Some interesting permafrost and ground-ice structures and existing glacial ice and ice shelves are described. A synthesis of the glacial retreat for the region is attempted. Most of the deposits formed during a period of rapid deglacierization and marine incursion.—*from* Author's abstract

11092 **Christie, R. L.** Surficial geology, northeastern Ellesmere Island, District of Franklin, and northwestern Greenland: Canada Geol. Survey Map 1192A (also in Bull. 138, 1967), scale 1:506,880, 1966.

Christie, R. L. *See* Muller, J. E. 11096

01493 **Churkin, Michael Jr.; Kay, Marshall.** Graptolite-bearing Ordovician siliceous and volcanic rocks, northern Independence Range, Nevada: Geol. Soc. America Bull., v. 78, no. 5, p. 651-668, illus., tables, geol. map, 1967.

Three new formations considered subdivisions of the Valmy Formation consist of over 2,000 feet of quartzite, shale, chert and pillow lava. The Snow Canyon Formation containing lower Ordovician graptolites is exposed in the deeper canyons of the range. It is overlain by the dominantly quartzitic McAfee Formation followed by the chert-rich Jacks Peak Formation. Graptolites in the Jacks Peak are late medial Ordovician. Correlation with siliceous assemblages in widely separated parts of Nevada is possible. Structural features involving block faulting and the Seetoya thrust considerably complicate facies and stratigraphic relationships in the Independence Range.—JJH

Cifelli, Richard. *See* Towe, Kenneth M. 01689

Clabaugh, Stephen. *See* Corpus Christi Geological Society. 11067

11060 **Clark, T. H.** Chateauguay area, Chateauguay, Huntingdon, Beauharnois, Napierville and St. Jean Counties [also French edition]: Quebec Dept. Nat. Resources Geol. Rept. 122, 63 p., illus., table, geol. map, 1966.

This area southwest of Montreal, the southernmost part of the St. Lawrence Lowland of Quebec, is underlain by Cambrian and Ordovician dolomite and sandstone of a probable Adirondacks source. The Chambly-Fortierville syncline dominates the eastern part but dies out at the international border. Rocks of the Covey Hill Formation, lowest division of the old Potsdam sandstone, are the oldest, succeeded to west, north, and east by concentric belts of nearly horizontal younger rocks in which there are Covey Hill outliers. The steep north and east flanks of Covey Hill are interpreted as scarps of Havelock and Stockwell faults. The stratigraphy of the Potsdam and Beekmantown Groups is described in detail. Local rocks are sources of building stone, road material, and silica sand.—GDC

11074 **Clarke, Otis M., Jr.** Clay and shale of northwestern Alabama: Alabama Geol. Survey Circ. 20-B, 88 p., illus., tables, geol. map, 1966.

In this area predominantly Mississippian and Pennsylvanian sedimentary rocks crop out and dip gently southward, overlapped by westward-dipping unconsolidated clastic sediments of Upper Cretaceous age. Tripoli deposits in weathered residuum of the Fort Payne Chert, shale from the Gasper, Pennington, and Pottsville Formations, and underclays in the Warrior coal basin are possible ceramic materials resources. Clay overlying the Tuscumbia Limestone in the Tennessee Valley can be made into brick and structural products. Some Cretaceous clay lenses and pockets are extensive and of potential value. Small pockets of bauxitic clay occur in gravel of the Tuscaloosa Group in Colbert County. Mineral analyses for three clays and basic data for 50 samples are given.—GDC

01670 **Clarke, Roy S., Jr.; Wosinski, John F.** Baddeleyite inclusion in the Martha's Vineyard tektite: Geochim. et Cosmochim. Acta, v. 31, no. 3, p. 397-406, illus., 1967.

A baddeleyite inclusion has been identified in the Martha's Vineyard tektite. The morphology of this inclusion is shown to be different from that of the baddeleyite inclusions reported in impactite. The presence of baddeleyite in the tektite, however, suggests another similarity between tektites and impactites.—DBV

01432 **Clarke, T. H.; Kranck, E. H.; Philpotts, A. R.** Ile Ronde breccia, Montreal: Canadian Jour. Earth Sci., v. 4, no. 3, p. 507–513, illus., table, 1967.

The breccia occupying most of St. Helen's Island and Ile Ronde was originally considered to be sedimentary, later volcanic, and is now attributed to diatreme action. It contains fragments of all local formations including the Precambrian basement and also Devonian limestone blocks. Recent excavations on Ile Ronde have shown fracture zones in the breccia filled exclusively with fragments of the adjacent Utica shale. More important is a new type of breccia consisting of sub-rounded masses of Precambrian quartzites and other rocks (but no anorthosite) held in a matrix of olivine diabase of Monteregian affinities.—Authors' abstract

01638 **Clayton, Lee; Freers, Theodore F.** Roadlogs—Jamestown to Bismarck by way of Lehr; Bismarck to Jamestown, *in* Glacial geology of the Missouri Coteau Midwest Friends of the Pleistocene, Field Conf. 1967, Guidebook: North Dakota Geol. Survey Misc. Ser. 30, p. 1–24, illus., 1967.

A field trip between Jamestown and Bismarck, N. Dak., was undertaken to examine the glacial features of the area. The various stops included examination and explanation of moraines, drift, superglacial till, alluvium, lake sediments, disintegration trenches and ridges, and collapse features.—LLP

Clayton, Lee. *See* Friends of the Pleistocene, Midwest. 01643

01648 **Clayton, Lee.** Stagnant-glacier features of the Missouri Coteau in North Dakota, *in* Glacial geology of the Missouri Coteau—Midwest Friends of the Pleistocene, Field Conf. 1967, Guidebook: North Dakota Geol. Survey Misc. Ser. 30, p. 25–46, illus., 1967.

Dead ice moraines, disintegration ridges and trenches, collapsed sediments, and ice-walled-lake plains in this area have resulted from stagnation of a late Wisconsin glacier from about 12,000 to 12,500 B.P. Stagnation was followed by a pluvial period with greater precipitation and runoff and slightly lower temperatures than at present. The superglacial environment was at first very active with rapid melting of ice and slumping of drift, then later became more stable with reduced melting and slumping. Streams began to flow westward toward the Missouri River depositing large amounts of superglacial sand and gravel on the Coteau. About 9,000 B. P., most of the ice melted and the drainage became non-integrated. As the climate became dryer, salts accumulated and aquatic environments deteriorated.—LLP

Clayton, R. N. *See* Walter, L. S. 01602

Clement, Jerry T. *See* Jakway, George E. 01447

Clifton, H. E. *See* Vedder, J. G. 01856

01466 **Coe, Robert S.** Paleo-intensities of the Earth's magnetic field determined from Tertiary and Quaternary rocks: Jour. Geophys. Research, v. 72, no. 12, p. 3247–3262, illus., tables, 1967.

A variety of rock types from 18 volcanic units of the western United States were studied by Thellier's method. Ninety-five NRM–TRM curves were determined, and paleo-intensities are estimated from 12 of the units. It is concluded from the results that (1) the paleo-intensity during the past few million years may not have exceeded about twice the present value; (2) the intensity of the dipole field decreases during polarity reversals; and (3) within the past ten thousand years the geomagnetic intensity has fallen to less than half the present value, but the direction of the field remained typically normal and no reversal occurred. Fragmentary evidence suggests that this has happened at least several times in the Pleistocene.—DBV

Cohen, Alvin J. *See* Reid, Arch M. 01472

01766 **Coker, Alfred E.; Milici, Robert C.; Finlayson, C. Pratt.** Geologic map of the Billingsley Gap quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 110-NW [sheet 1], scale 1:24,000, sections, separate text, 1967.

The accompanying text, "Mineral resources summary of the Billingsley Gap quadrangle, Tennessee" by Coker and Milici, and coal map by Coker are cited separately.—MCM

01767 **Coker, Alfred E.** Coal map of the Billingsley Gap quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 110-NW [sheet 2], scale 1:24,000, separate text, 1967.

The accompanying text, "Mineral resources summary of the Billingsley Gap quadrangle, Tennessee," by Coker and Milici, and geologic map by Coker, Milici and Finlayson are cited separately.—MCM

01768 **Coker, Alfred E.; Milici, Robert C.** Mineral resources summary of the Billingsley Gap quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 12 p., tables, 1967.

This text accompanies Tennessee Div. Geology Geol. Map GM 110-NW (geologic map, Coker, Milici, and Finlayson; coal map, Coker, cited separately). Mined mineral resources in the Billingsley Gap quadrangle are coal and dimension sandstone. In 1963 there was one active coal mine; there are at least 47 abandoned mines and prospects in the Bon Air, Wilder, Richland, Sewanee, Lantana, and other seams. Coal-bearing rocks are of the Pennsylvanian lower Pottsville Series and underlie approximately the northwestern 75 percent of the quadrangle. Estimated reserves of recoverable coal are 377,856 tons in beds more than 28 inches thick. Dimension sandstone in an abandoned quarry ranges from 2 inches to 3 feet in thickness; quarry dimensions are about 100 by 200 feet and average face is about 20 feet. Potential resources are sand, chert, limestone, and shale.—MCM

Coker, Alfred E. *See* Milici, Robert C. 01769

01770 **Coker, Alfred E.** Coal map of the Melvine quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 110-NE [sheet 2], scale 1:24,000, separate text, 1967.

The accompanying text, "Mineral resources summary of the Melvine quadrangle, Tennessee," by Coker and Milici, and geologic map by Milici and Coker are cited separately.—MCM

01771 **Coker, Alfred E.; Milici, Robert C.** Mineral resources summary of the Melvine quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 11 p., tables, 1967.

This text accompanies Tennessee Div. Geology Geol. Map GM 110-NE (geologic map, Milici and Coker; coal map, Coker, cited separately). Although there were no active coal mines in 1964, 14 abandoned mines or prospects in six seams indicate that coal has been mined on a small scale. The Pennsylvanian lower Pottsville Series underlies about half of the quadrangle; seams are high- to medium-volatile A bituminous coals. Estimated reserves of recoverable coal are 2,079,000 tons, all in the Lantana seam and in beds more than 28 inches thick. There are abundant reserves of limestone in 12 formations; the Murfreesboro, Ridley, Carters, Bigby-Cannon, Catheys, St. Louis, Monteable, and Bangor contain either more suitable or more available stone. Potential resources are sand, sandstone and shale.—MCM

01721 **Colquhoun, D. J.; Johnson, H. S., Jr.** Major Tertiary sea level fluctuation in South Carolina [abs.], *in* Tertiary sea-level symposium: Coastal Research Notes, v. 2, no. 4, p. 7-8, 1967.

01535 **Cook, Kathryn H.; Cook, Walter A.** The origin of geodes—Pt. 1: Gems and Minerals, no. 357, p. 14-17, illus., 1967; Pt. 2, ibid., no. 358, p. 18-20, illus., 1967.

A theory is postulated here that fossil echinoderms may be the origin of some geodes, thunder eggs, sandspikes, chalcedony roses, and many concretions. Geodes observed in Indiana and a number of other states show characteristic stem ends, plates and columns, and a few calyxes. With no satisfactory explanation for the holes in which geodes are thought to have formed, the authors believe the fossils are the core of the geodes, some coated in place on the sea bed during evaporation and burial, others broken loose and deformed in reworking, with additional mineralization.—GDC

Cook, Walter A. *See* Cook, Kathryn H. 01535

01406 **Cooke, David Lawrence.** The Timiskaming volcanics and associated sediments of the Kirkland Lake area [abs.]: Dissert. Abs., Sec. B., Sci. and Eng., v. 27, no. 9, p. 3146B–3147B, 1967.

Cooke, H. B. S. *See* Whitmore, F. C., Jr. 01477

Cooper, Byron N. *See* Ray, Clayton E. 01710

01789 **Cooper, G. Arthur; Muir-Wood, Helen M.** New names for brachiopod homonyms: Jour. Paleontology, v. 41, no. 3, p. 808, 1967.

Alitaria is substituted for *Alifera* Muir-Wood and Cooper (1960, p. 208, in "Morphology, classification . . . Productoidea. . .") *non Alifera* Piette (in D'Orbigny, 1891, p. 505). *Costellarina* is substituted for *Costellaria* Muir-Wood and Cooper (1960, p. 123) non *Costellaria* Swainson (1840, p. 320).

Corbató, Charles E. *See* Hall, Clarence A., Jr. 01374

01778 **Cordova, R. M.; Mower, R. W.** The effect of pumping large-discharge wells on the ground-water reservoir in southern Utah Valley, Utah County, Utah: Utah State Engineer Inf. Bull. 18, 35 p., illus., tables, 1967.

The purpose of an extensive aquifer test was to obtain data about the hydraulic characteristics of the Utah Valley aquifer and to determine whether pumping large-diameter wells decreased artesian pressures and resulting flow from the numerous small-diameter flowing wells in the valley. Data indicate that pumping in the area of large-discharge wells contributes to a general lowering of water levels in the valley. Pumping from wells that tap deep horizons lowers the water levels in wells tapping shallower horizons. Mutual interference among flowing wells in some areas may result in greater water-level declines in flowing wells than is caused by pumping.—MCM

11070 **Core, Earl L.** Plant migrations, Chap. 12 *in* Vegetation of West Virginia: Parsons, W. Va., McClain Printing Co., p. 139–150, illus., 1966.

The region occupied by West Virginia has been constantly above water since the close of the Permian and was outside the limits of Pleistocene glaciation, so the present flora is the result of migrations over a long period of time. Topics discussed cover the coming of the Angiosperms, origin of the Coastal Plain flora, the arctotertiary flora, Tertiary segregations, Pleistocene glaciation, retreat of the ice, the Xerothermic period, and recent migrations.—ESL

01499 **Corpus Christi Geological Society.** Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., 212 p., illus., tables, 1967.

Thirty-six oil and gas fields of the Gulf Coastal Plain in southern Texas were studied by various geologists and oil and gas companies. Each field resumé includes exploration, field, and reservoir data, and stratigraphy, character of the gas or oil, production history, structural maps, and cross-sections. Also included are the regional features, stratigraphy, and a generalized column for southern Texas.—LLP

11067 **Corpus Christi Geological Society; Clabaugh, Stephen; Barnes, Virgil E.; Young, Keith; Keith, Walter.** (leaders). Geology of the Austin-Llano area, central Texas, annual field trip, May 1966—Supp. to Guidebook 5 and Univ. Texas Bur. Econ.

Geology Guidebook 5 (reprinted): Corpus Christi, Tex., Corpus Christi Geol. Soc., supp., 23 p., illus., 1966; guidebook, p. 55–131, originally published 1962.

To enable the participants of this field trip to better understand the Precambrian through Mesozoic history of the unusually interesting and much studied central Texas area, this supplement contains a road log of the original GSA field trip stops from Guidebook 5 and several additional stops with descriptions of their geology. For descriptions of the original stops the reader is referred to Guidebook 5 which is bound with this supplement (originally published by the Houston Geol. Soc., also Texas Univ.). (See Bibliography of North American Geology 1962 for individual guidebook papers by V. E. Barnes, S. E. Clabaugh, P. E. Cloud, Jr., Keith Young, and R. C. McGehee).—GDC

Corry, Charles E. *See* Sclater, John G. 01642

Coutts, John W. *See* Gray, Dwight E. 11091

01860 **Crawford, Carl B.; Eden, William J.** Stability of natural slopes in sensitive clay: Am. Soc. Civil Engineers Proc., v. 93, paper 5324, Jour. Soil Mechanics and Found. Div., no. SM 4, p. 419–436, illus., tables, 1967.

Failures of natural slopes in sensitive clays often retrogress leaving a characteristic crater which is wider than the opening in the slope. Two actual failures of this type occurred near Ottawa, Canada. One occurred several hundred years ago but changes in ground water conditions since failure appear to have increased the stability of adjacent slopes in that area. The second failure, in an area of active sliding, occurred in 1963. In each case the required strength for stability under various ground water conditions has been computed and compared with measured values. It is concluded that an effective stress analysis of these slopes yields satisfactory results if tests are conducted in the working stress range and ground water conditions are carefully measured.—*from* Authors' abstract

Crawford, Thomas J. *See* Hurst, Vernon J. 11089

Crist, Marvin A. *See* Lowry, Marlin E. 01781

Crocket, J. H. *See* Faure, G. 01597

Currie, K. L. *See* Ermanovics, I. F. 01434

01692 **Cys, John M.** Osteology of the pristerognathid *Cynariognathus platyrhinus* (Reptilia, Theriodontia): Jour. Paleontology, v. 41, no. 3, p. 776–790, illus., table, 1967.

The first known complete skeleton of the primitive mammal-like reptile *Cynariognathus platyrhinus* from the Middle Permian of South Africa shows both primitive and advanced features, the former outnumbering the latter. The pectoral girdle, pelvic girdle, astragalus, and calcaneum are all primitive in morphology. The structure of the stapes and vertebrae, well-defined lumbar ribs, and phalangeal formula of 2–3–3–3 are all advanced characters. Moreover some very specialized features occur in the scapula, lumbar ribs, and manus. The primitive therocephalians could be the ancestors of all the advanced therocephalians, bauriamorphs, and very probably the cynodonts. However, the above specializations make it unlikely that *Cynariognathus* is on the main therocephalian evolutionary line.—*from* Author's abstract

11068 **Dalquest, Walter W.; Hughes, Jack T.** A new mammalian local fauna from the lower Pliocene of Texas: Kansas Acad. Sci. Trans., v. 69, no. 1, p. 79–87, illus., tables, 1966.

The new fauna was discovered at the headwaters of South Plum Creek, near Exell, Moore County, in Clarendonian sandstone. The specimens collected include jaws of hyaenoid dogs and a rare rhinoceros, and remains of five species of horses, all of which are described and illustrated.—ESL

Daly, Olive. *See* Siegel, S. M. 01600

11076 **Daniel, Thomas W., Jr.; Neathery, Thornton Lee; Simpson, Thomas A.** Rocks and minerals of Alabama—A guidebook for Alabama rockhounds: Alabama Geol. Survey Circ. 38, 106 p., illus., table, 1966.

This publication provides information about occurrences of rocks and minerals in Alabama to encourage and guide young people who are interested in the hobby of rock and mineral collecting. The first part contains brief definitions of rocks, minerals, and geologic processes; notes on how to plan a mineral collecting trip; and a short summary of basic field tests to distinguish rocks and minerals. The second part contains descriptions and locations of many rocks and minerals found in the State.—GDC

D'Appolonia, D. J. *See* D'Appolonia, E. 01894

01894 **D'Appolonia, E.; Alperstein, R.; D'Appolonia, D. J.** Behavior of a colluvial slope: Am. Soc. Civil Engineers Proc., v. 93, paper 5326, Jour. Soil Mechanics and Found. Div., no. SM 4, p. 447–473, illus., tables, 1967.

Methods of supporting the toe of a potentially unstable colluvial slope are discussed with reference to a site in the panhandle of West Virginia. The geology of the site is described, relating to the use of the applicable effective stress strength parameters—the residual, peak, or in-between. Field and laboratory evidence is presented to advance the hypothesis that "healing" of the slickensides has occurred, although the mechanism is not known. The stress path technique is used to describe the most economical means of toe support. Construction control, by means of a compressive instrumentation system, is described. Field observations of pore pressures, subsurface movements, and anchor tie loads are presented to support the concepts.—*from* Authors' abstract

01758 **Darton, N. H.** (compiler). Geologic map of South Dakota: Washington, D.C., U.S. Geol. Survey, scale 1:500,000, reprinted 1967; originally published 1951.

11054 **Davies, David K.; Ehrlich, Robert.** An objective evaluation of the sedimentary structural complexity of a fluvial bar: Sedimentology, v. 7, no. 3, p. 179–190, illus., tables, 1966.

A method, here developed, yields data which are a function of the thickness and orientation of visually homogeneous elements that, juxtaposed, comprise a sedimentary structure. Based upon a progressive enlargement of the field of vision about a point until the included area is first nonuniform, this method yields diameters which are related to both structural type and sampling plan. Sediments on a point-bar in the Mississippi River, near Baton Rouge, La., were studied in this manner. The method discriminated efficiently between structural varieties, and allows the structural complexity of a point-bar to be given a succinct quantitative description. Morphotypes and grain-size relationships are tabulated as well as variations and analyses of data. A significant lack of uniformity of structural density is indicated on Duncan Point.—GDC

Davis, E. L. *See* Rogers, Malcolm J. 11093

01687 **Davis, R. M.** Ice surface movement on the Tuto ramp in north Greenland: U.S. Army Materiel Command Cold Regions Research and Eng. Lab. Tech. Rept. 164, 24 p., illus., tables, 1967.

As part of a study of road construction on glacier ice, this report covers measurements from 1956 through the 1963 thaw season; procedure is described and movement data tabulated. Short-term horizontal movements and station elevations are recorded in appendix tables. Rate and direction of both the vertical and horizontal movement on the Tuto ramp are fairly consistent on an annual basis. The upward vertical movement from Station 28 to 58 on the original ramp road is probably caused by the ice upthrust over a stagnant wedge of ice at the edge of the glacier. The small amount of horizontal movement at the edge of the glacier is further evidence of this wedge.—GDC

01481 **Dawdy, D. R.; Feth, J. H.** Application of factor analysis in study of chemistry of groundwater quality, Mojave River valley, California: Water Resources Research, v. 3, no. 2, p. 505–510, illus., tables, 1967.

Chemical analyses showed three principal chemical types of water: calcium bicarbonate, sodium sulfate, and sodium chloride. Data were studied by factor analysis to learn the relative importance of each principal ion in determining the variations among the samples, and to examine the possibility of chemical equilibrium between aqueous and solid phases in the aquifers. Most of the covariance in the system may be accounted for by variances of Ca^{+2}, Mg^{+2}, Na^{+2}, SO_4^{-2}, and Cl^{-1}; the variance in chemical composition of the system is governed largely by NaCl sources; concentrations of NO_3^{-1} and F^{-1} vary independently of other constituents. Although sources of the constituents must be deduced from geologic and hydrologic evidence, factor analysis furnished the critical information on chemical relationships basic to the deduction.—*from* Authors' abstract

11059 **Dearnley, R.** Orogenic fold-belts and a hypothesis of Earth evolution, *in* Physics and chemistry of the Earth, V. 7: London and New York, Pergamon Press, p. 1–114, illus., tables, 1966.

A model of Earth evolution is presented based on the convection current systems postulated by Runcorn (1962) and on the geotectonic grouping proposed by Sutton (1963). The model is that of an expanding Earth, having a "cold" accretionary origin, in which gradual growth of the core promotes changes in the convection current system in the mantle, and the activity of the mantle is related in a systematic way to the major features of the Earth's crust. The worldwide orogenic fold-belt distributions are outlined from the earliest recognizable Precambrian structural regime, and their significance examined in relation to the theory of continental drift and to the proposed evolutionary Earth model. Crustal tectonic data from Precambrian fold-belts gives particular support to the model.—VSN

01461 **Degens, Egon T.** Evolutionary trends inferred from the organic tissue variation of mollusc shells: Dansk Geol. Foren. Medd., v. 17, no. 1, p. 112–114, illus., tables, 1967.

Research at Woods Hole Oceanographic Institution, Mass., on comparative biochemistry and shell calcification in mollusks is outlined briefly. Proteins secreted by the mantle are analyzed principally by three techniques—amino-acid analysis, protein solubility test, and factor analysis (to show grouping of amino acids with respect to taxa). Geometric means of calcified and uncalcified organic tissues of various invertebrates are tabulated for 19 amino acids. A phylogenetic tree of Mollusca based on amino-acid factor scores is presented. Relations of amino-acid patterns to shell morphology in evolutionary series of Tertiary gastropod species (*Planorbis*, Miocene, Germany) demonstrate that morphology is only a macroscopic expression of the molecular biology of the shell matrix, which is controlled by range in temperature and salinity.—VMJ

Delorme, L. D. *See* Klassen, R. W. 01428

01695 **Delorme, L. D.** Freshwater ostracode synonyms: Jour. Paleontology, v. 41, no. 3, p. 792–794, illus., 1967.

The candonids *Candona obtusa* Bronstein, 1947 and *Candona sappaensis* Staplin, 1963 have been given various specific names by various authors in North America. A search of the literature and a comparison of the taxa types has reduced the number of specific names from nine to two.—Author's abstract

01681 **Dennis, John G.** (compiler and editor). International tectonic dictionary—English terminology: Am. Assoc. Petroleum Geologists Mem. 7, 196 p., illus., 1967.

The function of the International Tectonic Dictionary is to provide a guide to past and present usage of English tectonic terms and to make recommendations where ambiguity exists. A basic principle is that genetic and descriptive terminology be kept apart. Each annotation is subdivided into derivation, definition, history and

usage, synonyms, and related terms; in some cases explanations and recommendations are added.—LLP

01793 **Dennison, John M.; Hay, William W.** Estimating the needed sampling area for subaquatic ecologic studies: Jour. Paleontology, v. 41, no. 3, p. 706–708, illus., 1967.

Most traditional methods of subaquatic ecologic sampling do not collect large enough areas to provide quantitatively reliable census data. Binomial sampling theory can be used to calculate the size of randomly selected area from a benthonic community which should be examined in detail to assure that a species occupying p proportion of the benthonic surface will be missed by random sampling no more than Y proportion of the time. A graph facilitates these determinations. The graph can also be applied to the probability of a species being absent by chance from a collection of individual organisms.—Authors' abstract

01595 **deWaard, D.; Walton, M.** Precambrian geology of the Adirondack highlands, a reinterpretation: Geol. Rundschau, no. 56, no. 2, p. 596–629, illus., 1967.

In two representative areas of the Adirondack highlands, major bodies of anorthosite and gneisses of the quartz-syenite and charnockite series are shown to occupy cores of mantled domes and nappes. They are part of a pre-Grenville basement with geology heavily masked by the Grenville orogeny. "Grenville metasediments" were supracrustal rocks deposited on the eroded surface of this basement. The pre-Grenville basement consists of relatively homogenous masses of meta-anorthosite, metanorite, charnockite, and granitic gneisses. The supracrustal rocks occur in well defined sequences of varied metasediments, gneisses, and charnockites.—DBV

01633 **Dickas, A. B.; Payne, J. L.** Upper Paleocene buried channel in Sacramento Valley, California: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 6, pt. 1, p. 873–882, illus., 1967.

The Meganos channel is a fossil submarine channel that was cut and filled in a marine environment during late Paleocene time. It is more than 50 miles long, and as much as 6 miles wide. The greatest known thickness of sediments filling the channel is 2,015 feet. Rocks eroded by the channel are principally arenaceous; however, sediments filling the channel are more than 95 percent shale that accumulated in water depths ranging from neritic to upper bathyal. Movement on the Midland fault may have contributed to the formation of the channel by setting up conditions favorable for extensive slumping and turbidity currents which caused erosion of the sea floor and development of the channel. Burial and overburden pressures compacted the channel shale to 35–60 percent of its original volume.—WCC

01680 **Dickinson, Arthur S.** Paleo-structural analysis and application of later structural tilting [abs.]: South Texas Geol. Soc. Bull., v. 7, no. 5, p. 1–2, 1967.

01842 **Dideriksen, R. I.** The geology and soils of Iowa—[Pt. 2] A look at Iowa's soils: Jour. Soil and Water Conserv., v. 22, no. 3, p. 112–114, illus., tables, 1967.

About 95 percent of Iowa's soils developed from Wisconsin loess, glacial tills of four ages, and Recent alluvium. The balance developed from pre-Wisconsin loess and exposed sedimentary rocks. The surface of loess-mantled divides is 14,000 yr old, and glacial till divides in the northeast are 12,000 yr old. About 280 soil series in Iowa have been mapped, of which a few closely associated major soils have been grouped into 20 major soil associations; these are shown on a map and described under the sections of the State in which they occur.—ESL

01484 **Dietz, Robert S.** More about continental drift: Sea Frontiers, v. 13, no. 2, p. 66–82, illus., 1967.

One of the great geologic debates is over the question of whether the position of continents has always been fixed, or whether they have drifted to their present position. The Laurasia-Gondwana concept seems the strongest of the drift theories. Paleomagnetic, ocean floor, and fossil evidence are reviewed. Movement of the

continents on the mantle is compared to large icebergs on the ocean, and attempts to reconstruct the ancient supercontinents are described. Speculation as to how the continents dispersed, commencing late in the Jurassic and ending by the close of the Mesozoic, is included.—ESL

01780 **Dimroth, Erich.** Geology of Dunphy Lake area, New Quebec Territory [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. 557, 16 p., tables, geol. map, 1966 [1967].

All beds in the map-area are Precambrian, consisting of red beds, a reduced thickness of the Knob Lake Group cut by gabbro sills and overlain by a thick sequence of Doublet Group basalts. In the northeastern corner, the Knob Lake Group is more complete, gabbro sills are absent, and the Doublet Group amphibolites are not very abundant. The map-area is divided by thrust faults into three tectonic units. All were affected by the Hudsonian orogeny, the less competent beds in the northeast being more strongly folded. Traces of metal mineralization were detected along boundaries of tectonic units.—ESL

01684 **Dole, Hollis M.** Geology is for everyone—Fifteenth biennial report of the State Geologist, 1964–1966: Oregon Dept. Geology and Mineral Industries Bull. 59, 27 p., illus., tables [1967].

This report summarizes recent investigations and projects: for land development in the Willamette Valley, on the Oregon coast, and on volcanic terrain; for the recreationist—the geology of State Rock and other parks, and the museum; for the student—the library, publications, mineral sets, and speaker and letter service; for the mineral investigator—geologic mapping progress, geophysical and chemical programs; for industrial development—geothermal energy, mineral industry and exploration, and petroleum; and the Department organization.—GDC

01806 **Donahue, B. A.; Leonard, J. W.** Petrography for coal mining and coal preparation: Soc. Mining Engineers Trans., v. 238, no. 2, p. 147–153, illus., table, 1967.

A method is described for incorporating coal petrography into mining and preparation plant quality control based on conventional analyses. Complete analyses are made of each of the uniform and relatively distinct petrographic bands in a coal face. With this information it is possible to develop petrographic standardization curves. These curves permit diverse coal characteristics to be rapidly monitored by application of a few standard coal tests. Single seam quality control is discussed in this paper.—Authors' abstract

01407 **Doney, Hugh Holt.** Geology of the Cebolla quadrangle, Rio Arriba County, New Mexico [abs.]: Dissert. Abs., Sec. B., Sci. and Eng., v. 27, no. 9, p. 3147B, 1967.

01408 **Dover, James Herbert.** Bedrock geology of the Pioneer Mountains, central Idaho [abs.]: Dissert. Abs., Sec. B., Sci. and Eng., v. 27, no. 9, p. 3147B–3148B, 1967.

11082 **Dubois, J.** Temps de propagation des ondes P à des distances épicentrales de 30 à 90 degrés, region du sud-ouest Pacifique [with English and Russian abs.]: Annales Géophysique, v. 22, no. 4, p. 642–645, illus., table, 1966.

The time of propagation of P-waves from a nuclear explosion in the Aleutian Islands on October 29, 1965, for the region of the southwestern Pacific between the epicentral distances of 30° to 90° is compared with that for the continents of North America, Europe, and Asia. Epicentral distances and the time residual factors are tabulated for each station. Results imply that the correction to the Jeffreys-Bullen tables at about 70° changes from −5 sec under continents to −1.5 sec under the Pacific Ocean. The difference is examined in the light of observations of Tryggvason (1964) for Iceland and Scandinavia, in which he suggests that the difference in mean residuals is caused by different wave velocities at depths less than D (the depth below which the mantle is homogeneous) near individual stations.—VSN

Dukleth, Gordon W. *See* Jansen, Robert B. 01886

Durham, C. C. *See* Holman, R. H. C. 01682

Durham, D. L. *See* Vedder, J. G. 01856

01706 **Durham, J. Wyatt.** The incompleteness of our knowledge of the fossil record: Jour. Paleontology, v. 41, no. 3, p. 559–565, table, 1967.

Our knowledge of the fossil record will not be complete until we have a continuum of morphologies between all taxa with preservable parts. [At that time] species boundaries between sequential taxa will have to be arbitrary. Small samples do not yield reliable information on the variability of a fauna. A sample of over 67,000 molluscs from a late Pleistocene marine pocket near Newport, Calif., contained 427 taxa. A one percent sample obtained in the same manner would yield only 153 taxa and a sample of 68 specimens would yield only 48 taxa. Analysis of fossilizable marine invertebrates and the known fossil record suggests that we know only about one of every 44 taxa of those that have existed since the beginning of the Cambrian.—*from* Author's abstract

01503 **Dyer, Byron F.** Bird Island, Kleberg County, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 28–29, illus., tables, 1967.

01581 **Dyer, Byron F.** Harvey Field, San Patricio County, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 69–70, illus., tables, 1967.

Dymond, Jack D. *See* Bieri, Rudolf H. 11098

Eckel, Edwin B. *See* Hansen, Wallace R. 11108

Eden, William J. *See* Crawford, Carl B. 01860

Edgar, A. D. *See* Ermanovics, I. F. 01434

11099 **Edward E. Johnson, Inc.** Ground water and wells (1st edition): Saint Paul, Minn., Edward E. Johnson, Inc., 440 p., illus., tables, 1966.

The first six chapters cover the importance of water to man; origin, occurrence, and movement of ground water; ground-water regions of the United States and Venezuela; chemical character of ground water; testing water wells for drawdown and yield; and well hydraulics. Ground-water exploration, and analysis of sand samples comprise chapters 8 and 9. The other 14 chapters deal with design, drilling, and completion of wells, screens, pumps, and the like.—ESL

Ege, John R. *See* Noble, Donald C. 01854

01844 **Egiazaroff, I. V.** Sediment transportation mechanics—Initiation of motion—Discussion [of paper 4738 by ASCE Task Comm, 1966]: Am. Soc. Civil Engineers Proc., v. 93, paper 5304, Jour. Hydraulics Div., no. HY 4, p. 281–287, illus., 1967.

Analysis of Egiazaroff's earlier data on initiation of motion (referred to in paper 4738, ibid., v. 92, no. HY 2, p. 291–314, 1966) has shown the necessity of adding new experimental points. Figure 2–E.22 shows more than 220 points, the theoretical curves of the writer, and experimental curves of Shields and Iwagaki. Despite point scatter caused by differences in sediment uniformity and measurement error, it is possible to establish that there are no important quantitative differences between these results and those of Shields.—LLP

01661 **Ehmann, William; Lovering, John F.** The abundance of mercury in meteorites and rocks by neutron activation analysis: Geochim. et Cosmochim. Acta, v. 31, no. 3, p. 357–376, tables, 1967.

Mercury abundances have been determined in all classes of chondrites, the principal classes of achondrites, alkali and tholeiitic basalts, differentiated tholeiitic basalt intrusions, possible lower crustal and upper mantle rock inclusions, and six standard crustal rocks. Relatively high Hg abundances previously reported in the carbonaceous chondrites are confirmed. The results suggest a more complex behavior for Hg in the evolution of meteorites than previously proposed. Possible lower crust or upper mantle materials have high Hg abundances, in the range of the basic achondrites, whereas the six standard crustal rocks have low abundances. Implications of the data with respect to estimation of cosmic abundances and the evolution of meteorites and the Earth are discussed.—DBV

Ehrlich, Robert. *See* Davies, David K. 11054

01572 **Eisenlohr, William S., Jr.** Measuring evapotranspiration from vegetation-filled prairie potholes in North Dakota: Water Resources Bull., v. 3, no. 1, p. 59–65, illus., 1967.

Many prairie potholes in North Dakota are filled with emergent aquatic vegetation. The paper describes briefly how evapotranspiration losses were determined for such potholes using a mass-transfer equation in which the coefficient was evaluated by means of a water budget. Vegetation, by its presences, reduces evaporation below normal from a free water surface so much that the total seasonal (May–October) evapotranspiration loss is less than the normal evaporation loss from a pothole clear of vegetation.—Author's abstract

01883 **Ellis, Willard; Hartman, V. B.** Dynamic soil strength and slope stability: Am. Soc. Civil Engineers Proc., v. 93, paper 5321, Jour. Soil Mechanics and Found. Div., no. SM 4, p. 355–375, illus., 1967.

Tests were performed on undisturbed fine-grained clay soil and on undisturbed and remolded fine-grained clayey and sandy clay soils to determine soil strength characteristics under dynamically applied stresses; results are compared to normal soil strengths at equivalent strains. The maximum normal soil strength is assigned a value of 100 percent, and soil strengths under pulsating stress expressed as a percentage of this. The studies show that confining pressure does not appreciably affect the relationship between normal and dynamic soil strength. Results show the dynamic soil strength to be generally up to 15 percent greater than the normal strength for overconsolidated plastic clays. However, dynamic soil strength is less than the normal by about 10 percent for low density, wet of optimum water content, sandy clays, especially at low strains.—*from* Authors' abstract

Emery, K. O. *See* Whitmore, F. C., Jr. 01477

01798 **Engelund, Frank.** Hydraulic resistance of alluvial streams—Closure [to discussions of paper 4739, 1966]: Am. Soc. Civil Engineers Proc., v. 93, paper 5304, Jour. Hydraulics Div., no. HY 4, p. 287–296, illus., 1967.

In the original paper (ibid., v. 92, no. HY 2, p. 315–326, 1966), the result was found to be unsatisfactory for very small sediment transport rates. Investigations of some additional consequences of the similarity principle and comparisons with flume tests and field observations are outlined. Two corrections to the original paper are included.—LLP

Erd, Richard C. *See* Christ, C. L. 01660

01435 **Erdtmann, Bernd-Dietrich.** A new fauna of Early Ordovician graptolites from St. Michel, Quebec [with French abs.]: Canadian Jour. Earth Sci., v. 4, no. 3, p. 335–355, illus., tables, 1967.

A locality 12 miles downstream from the type locality for the Levis Formation has yielded a new genus, *Stellatograptus*, and three variants of *Clonograptus sarmentosus* (Moberg) as well as other forms, suggestive of the fauna of the Hagastrand Member of the Lower Ordovician section at Oslo, Norway. Biometrical data on the dominant forms are tabulated and extensive revision for *C. sarmentosus* is offered.—Author's abstract

01590 **Ergin, Kazim.** Seismic evidence for a new layered structure of the Earth's core: Jour. Geophys. Research, v. 72, no. 14, p. 3669–3687, illus., tables, 1967.

A detailed structure of the core and lower mantle is deduced from observed traveltimes and amplitude–distance curves based on new data from the Worldwide Standardized Seismic Network. The results suggest lower velocity at the base of the mantle. PKP_2 data suggest a decrease in velocity at 4,015 km and discontinuous increases in velocity at 4,500 and 4,685 km. PKIKP data suggest two low–velocity layers within the core. The exact location and characteristics of the caustic at 142° are discussed. New velocity values suggest that between 4,015 and 5,140 km there is a layered transition zone where the general level of velocity is lower than the values obtained by extrapolation of the velocities in the outer part of the outer core.—DBV

01705 **Erickson, Bruce R.** Fossil bird tracks from Utah: Mus. Observer, v. 5, no. 1, p. 6–12, illus., 1967.

Footprints of a web–footed bird were found in a limy shale layer of the Green River Formation near Provo. The tracks are similar to those made by a swan or goose, except the bird was longer legged. For the present the specimen is referred to the category *incertae sedis*.—ESL

01376 **Eriksson, Erik.** Large–scale utilization of tritium in hydrologic studies, *in* Isotope techniques in the hydrologic cycle—Symposium, Univ. Illinois, 1965: Am. Geophys. Union Geophys. Mon. Ser., no. 11, p. 153–156, illus., 1967.

Tritium is an excellent tracer for circulation of water in nature in many of its phases and will be indispensable as a research tool during the Hydrologic Decade. The currently available data make it possible to study some large–scale phenomena like rate of exchange of water across the sea surface and rate of the exchange between sea surface water and deeper sea water. The hydrologic characteristics of river basins can also be studied, as well as similar characteristics of groundwater reservoirs. In these cases the characteristics, suitably defined, are revealed by the distortion of the tritium pulses in precipitation, which occur when water is passing through the reservoirs. For full utilization of large–scale tritium as a tracer in hydrologic studies, it is necessary to collect data over many future years.—Author's abstract

01434 **Ermanovics, I. F.; Edgar, A. D.; Currie, K. L.** Evidence bearing on the origin of the Belleoram stock, southern Newfoundland: Canadian Jour. Earth Sci., v. 4, no. 3, p. 413–431, illus., tables, 1967.

The Belleoram stock of homogeneous adamellite intruded igneous and sedimentary rocks of Cambrian to Late Devonian age. The data indicate that the stock is of magmatic origin. Differential assimilation of the host conglomerate and shales may have locally modified the composition of the crystallizing magma. Arkosic conglomerates near the stock have been altered to a granitic composition, the stock margins have been basified near shale contacts, and compositions of shale xenoliths have been altered. Hydrothermal experiments show that the magmatic vapor phase could transport sufficient amounts of soda, potash, alumina, and silica to explain the compositional variation. The results suggest that under suitable conditions combined processes of autometasomatism and assimilation may be an important factor in granitization and basification at the margins of shallow intrusions.—*from* Authors' abstract

01864 **Esrig, Melvin I.; Gemeinhardt, John P., Jr.** Electrokinetic stabilization of an illitic clay: Am. Soc. Civil Engineers Proc., v. 93, paper 5235, Jour. Soil Mechanics and Found. Div., no. SM 3, p. 109–128, illus., tables, 1967.

Remolded illitic clay cylindrical samples were treated electrokinetically for periods of between 8 hr and 11 days in the presence of a large supply of calcium ions at the anode. Measurements were obtained of the vane shear strength of the soil before and after treatment. When corrected for water content changes, these data lead to the conclusion that essentially no chemical cementation had occurred. It appeared that soil hardening was the result of decreases in the water content of the soil and of physical–chemical changes in the soil. Soil hardening occurred at a rate of about

1/2 inch per day throughout most of the soil specimen and was found to be directly related to the changes in pH and Atterberg limits.—*from* Authors' abstract

01697 **Evans, B. J.; Ghose, Subrata; Hafner, Stefan.** Hyperfine splitting of Fe^{57} and Mg–Fe order–disorder in orthopyroxenes ($MgSiO_3$–$FeSiO_3$ solid solution): Jour. Geology, v. 75, no. 3, p. 306–322, illus., tables, 1967.

The apparent "two–line" hyperfine spectrum of Fe–57 in some orthopyroxene minerals from metamorphic rocks has been analyzed by the Mössbauer technique. The spectrum consists predominantly of two overlapping two–line patterns. The patterns have been assigned to the two non–equivalent Fe sites, M_1 and M_2 of the crystal structure. The approximated intrinsic values of the electric quadrupole interaction and isomer shifts at M_1 and M_2 are given. The Fe site occupancies have been approximately determined. The high degree of Mg–Fe ordering in an orthopyroxene found previously by X–ray diffraction has been confirmed. Heat treatment of this sample at 1,000°C yields considerable Mg–Fe disorder.—*from* Authors' abstract

Evans, D. D. *See* Harshbarger, J. W. 01585

01796 **Everett, D. E.; Rush, F. Eugene.** A brief appraisal of the water resources of the Walker Lake area, Mineral, Lyon, and Churchill Counties, Nevada: Nevada Dept. Conserv. and Nat. Resources Water Resources—Reconn. Ser. Rept. 40, 44 p., illus., tables, 1967.

Consolidated rocks of the Walker Lake area (Precambrian to Tertiary) are assumed to have low permeability except for fracture zones. Late Tertiary and Quaternary alluvial deposits (gravel, sand, silt, and clay) are poorly consolidated to unconsolidated, well to poorly sorted, and in some areas are faulted and folded. Lake Lahontan occupied much of the valley floor in Walker Lake Valley and Rawhide Flats. Source of all ground water is from precipitation, seepage loss from Walker River, recharge, and subsurface flow from Mason Valley. Most water is contained in alluvium, but thickness of the reservoir is not known. In general, ground water is suitable for agricultural and domestic uses, however quality in the project area varies from place to place. It is estimated that since 1908 3,000 acre-feet of ground water has been lost annually from water in storage as levels in Walker Lake decline.—MCM

01879 **Ewing, John I.; Ewing, Maurice.** Sediment distribution on the mid–ocean ridges with respect to spreading of the sea floor: Science, v. 156, no. 3782, p. 1590–1592, illus., 1967.

An abrupt change in sediment thickness between the crests and flanks of the mid-ocean ridges can be interpreted as a major discontinuity in the rates either of spreading of the sea floor or of accumulation of sediment. The preferable interpretation of the data is that the process of spreading of the sea floor is intermittent and that the present cycle of spreading commenced around 10 million years ago, following a long period of quiescence during which most of the observed sediments were deposited.—Authors' abstract

Ewing, Maurice. *See* Ewing, John I. 01879

01791 **Fagerstrom, J. A.; Marcus, Leslie F.** Biometric study of ontogeny in the Pennsylvanian rugose coral *Pseudozaphrentoides verticillatus* from Nebraska: Jour. Paleontology, v. 41, no. 3, p. 649–659, illus., 1967.

In this rugose coral from the Upper Pennsylvanian Plattsmouth Limestone, eastern Nebraska, growth patterns were measured by considering insertion of each major septum as the beginning of a new growth stage. Growth of some protocorallites was arithmetic, of others, geometric. Septa are more closely spaced in immature than in mature portions of corallites, and diameter at any particular stage varies greatly. Therefore, spacing is considered of doubtful taxonomic value; parameters of growth curves are better for comparing samples.—REG

01821 **Fary, Raymond W., Jr.** Explorers from space: Jour. Geol. Education, v. 15, no. 3, p. 99–104, illus., 1967.

The program for the Earth Resources Observational Satellites (EROS) plans to launch the first of a series of satellites in 1970. EROS, directed by the U.S. Geological Survey, will be available for programs throughout the Interior Department and to other government agencies. The first satellite will probably have a television camera system to collect photographic data and may also be used as a communicating link to ground based sensors. The satellites will be especially useful for mapping large areas under uniform lighting, detecting regional effects of geologic processes, and providing (with the "straight-down" look of the camera) unique displays of land surface. The U.S. Geological Survey is presently studying the space applications of infrared, ultraviolet, and radar imaging devices.—LLP

01597 **Faure, G.; Crocket, J. H.; Hurley, P. M.** Some aspects of the geochemistry of strontium and calcium in the Hudson Bay and the Great Lakes: Geochim. et Cosmochim. Acta, v. 31, no. 3, p. 451–461, illus., tables, 1967.

The Sr-87/Sr-86 ratio in water and pelecypod shells from Hudson Bay is 0.7093 ± 0.0003, which is identical with the ratio in the northern Atlantic Ocean. Sr and Ca concentrations in four water samples from eastern Hudson Bay vary linearly with salinity and are appreciably lower than in the open ocean. The $Sr \times 10^3/Ca$ ratio in Hudson Bay (18.7 ± 0.3) does not differ significantly from values obtained for Atlantic Ocean surface water. Sr and Ca concentrations in Lake Superior are uniform throughout (21.8 ± 0.4 ppb and 14.3 ± 0.5 ppm, respectively), and the $Sr \times 10^3/Ca$ ratio is 1.53 ± 0.04; concentrations in Lake Huron are regionally variable and significantly higher. Sr seems to be concentrated relative to Ca in the oceans.—DBV

01526 **Fegan, George K.** Palo Alto Field, Victoria County, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 142–150, illus., tables, 1967.

11087 **Fell, H. Barraclough.** Ancient echinoderms in modern seas, *in* Oceanography and marine biology—An annual review, V. 4 (H. Barnes, editor): New York, Hafner Publishing Co., p. 233–245, table, 1966.

Echinoderms have been conspicuous in the benthos since the early Paleozoic and some surviving members differ little from the ancient. Since the division of the phylum into two subphyla based on habit seems to obstruct any satisfactory interpretation of their evolution, four subphyla based on patterns of symmetry are suggested: Homalozoa, Crinozoa, Echinozoa, and Asterozoa. Both adult and larval symmetry are discussed, including response to environment. Applications of these symmetry patterns to archaic Echinozoa, archaic surviving holothurians, and archaic surviving echinoids are described. Early evolution of the Asterozoa is discussed; the revised classification of the Echinodermata is shown in a table.—ESL

01819 **Felsher, Murray.** A slope-correction chart for determining true angle of slope from an exaggerated profile: Jour. Geol. Education, v. 15, no. 3, p. 116, illus., 1967.

A chart is presented as an aid in determining true slope in degrees when given the exaggerated slope and vertical exaggeration of the profile. For any exaggerated angle, a curve can be drawn from the angle's tangent values.—LLP

01746 **Feltis, R. D.** Ground-water conditions in Cedar Valley, Utah County, Utah: Utah State Engineer Tech. Pub. 16, 34 p., illus., tables, geol. map, 1967.

Cedar Valley is mostly a topographically closed basin, developed in a structural trough caused principally by faulting, bordered by mountains largely composed of Paleozoic sedimentary rock, and filled with semiconsolidated to unconsolidated Tertiary and Quaternary deposits. Ground water occurs under both water-table and artesian conditions, but most wells are developed in the artesian aquifer. The source of most recharge is in the Oquirrh Mountains. Estimated subsurface outflow along the east edge of the valley ranges from about 10,000–20,000 acre-feet per

year. Coefficient of transmissibility in the north-central part ranges from about 5,000–25,000 gpd/ft. Specific capacities of irrigation wells in the center of the basin range from about 1–7 gpm/ft of drawdown; at the west edge two wells had 30–37 gpm/ft. Most ground water in the north and southwest is of good quality, whereas that in the southeast is poor.—*from* Author's abstract

01667 **Ferraes, Sergio G.** Test of Poisson process for earthquakes in Mexico City: Jour. Geophys. Research, v. 72, no. 14, p. 3741–3742, illus., table, 1967.

Results of a χ_2 test show that the annual number of earthquakes in Mexico City is not Poisson-distributed.—DBV

01547 **Ferrigno, Kenneth F.** An occurrence of the holothuroid sclerite *Protocaudina* from the Dundee Limestone (lower Middle Devonian), southern Ontario [abs.], *in* New York State Geol. Assoc., Guide book to field trips, 39th Ann. Mtg., New Paltz, N. Y., 1967: New York, City Coll. City Univ. New York, Dept. Geology, p. TK6, 1967.

Feth, J. H. *See* Dawdy, D. R. 01481

11066 **Feth, J. H.; Barker, D. A.; Moore, L. G.; Brown, R. J.; Veirs, C. E.** Lake Bonneville—Geology and hydrology of the Weber Delta district, including Ogden, Utah: U.S. Geol. Survey Prof. Paper 518, 76 p., illus., tables, geol. map, 1966.

The Weber Delta district, an area of about 400 sq mi, lies between the Wasatch Mountains and Great Salt Lake in north-central Utah. The Weber Delta, near the center of the district, is the largest of the Pleistocene deltas built in Lake Bonneville on an open plain. Formations exposed in the district consist of Precambrian and Cambrian consolidated rocks, Pleistocene unconsolidated rocks (Lake Bonneville Group), and sediments of Recent age. The Weber Delta district is subdivided according to the quality of the water pumped from the underlying aquifers, and each subdivision is analyzed. Although about 25,000 acre-feet of water is discharged by wells, about 20,000 acre-feet flow westward to discharge into Great Salt Lake.—LLP

01656 **Finks, Robert M.** S. A. Miller's Paleozoic sponge families of 1889: Jour. Paleontology, v. 41, no. 3, p. 803–807, 1967.

Miller named nine new sponge families in 1889; at least five of these were later named by, and ascribed to, other authors. This article puts the record straight.—REG

Finlayson, C. Pratt. *See* Milici, Robert C. 01763

Finlayson, C. Pratt. *See* Coker, Alfred E. 01766

01658 **Flanagan, Francis J.** U.S. Geological Survey silicate rock standards: Geochim. et Cosmochim. Acta, v. 31, no. 3, p. 289–308, tables, 1967.

The U.S. Geological Survey has processed six silicate rocks to provide new reference samples to supplement G-1 and W-1. Complete conventional, rapid rock, and spectrochemical analyses are reported for a granite, granodiorite, andesite, peridotite, dunite, and basalt. Analyses for variance of Ni, Cr, Cu, and Zr in each sample showed that for these elements, the rocks can be considered homogeneous. Spectrochemical estimates are given for the Ni, Cr, Cu, and Zr contents of the samples. The petrography is described for all except the granite, and CIPW norms are presented.—DBV

01556 **Fletcher, Frank W.** Middle and Upper Devonian clastics of the Catskill Front, New York, *in* New York State Geol. Assoc., Guide book to field trips, 39th Ann. Mtg., New Paltz, N. Y., 1967: New York, City Coll. City Univ. New York, Dept. Geology, p. C1–C23, illus., tables, 1967.

The Middle and Upper Devonian strata of the Catskill Mountains are, from bottom to top, limestones, shales, siltstones, sandstones, red beds, and conglomerates. The

"Catskill delta" theory in which the sediments are derived from a high mountain range of Precambrian crystallines is challenged. Alternate periods of regression and transgression during the Middle and Late Devonian are concluded to be the result of tectonic activity in the faulted and folded flank zone of the geosyncline, which is now occupied by the Taconic Mountains. Increased tectonic activity brougnt to the surface rocks that had formerly been deposited in the marginal troughs. Although the Ordovician rocks were the dominant source for the lower Catskill sediments, Devonian rocks from the marginal trough were the dominant source for the upper Catskill sediments.—LLP

01394 **Flock, William Merle.** Mineralogy and petrology of the Andersonville, Georgia, bauxite district [abs.]: Dissert. Abs., Sec. B., Sci. and Eng., v. 27, no. 9, p. 3205B, 1967.

01458 **Floris, Sören.** Scleractinian coral faunas of Denmark and West Greenland in Senonian, Danian, and Paleocene (Some preliminary results of a study) [with Danish abs.]: Dansk Geol. Foren. Medd., v. 17, no. 1, p. 150–152, 1967; summary—West Greenland scleractinian corals from Upper Cretaceous and Lower Tertiary, ibid., p. 192–193, 1967.

Undescribed Upper Cretaceous and Paleocene corals (Anthozoa, order Scleractinia) collected by A. Rosenkrantz and others have been studied, and previously published descriptions have been revised (unpublished). In Greenland, scleractinians are found only in Nugssuaq Peninsula; 43 species are recognized, many new. Although the lithologies are very different, Greenland faunas have at least 6 species in common with Denmark. The Senonian fauna has 3 solitary species, one in common with Denmark; the Danian has 25 solitary species, and 3 colonial dendroid species in common with Denmark; the Paleocene has 8 solitary species, 2 in common with Denmark, and 5 colonial, one with Cretaceous and Recent relatives in North America. Unlike Denmark, Greenland lacks reef-building forms.—VMJ

01569 **Ford, Derek C.** Sinking creeks of Mt. Tupper, a remarkable groundwater system in Glacier National Park, B.C.: Canadian Geographer, v. 11, no. 1, p. 49–52, illus., 1967.

The meltwater stream of Tupper Glacier and other drainage in the higher Tupper Valley goes underground in two sinks and is taken through the mountain along the strike of a narrow limestone-marble band, emerging in a large spring. The water flows 1.25 mi underground with a fall of 1,590 feet; dye tests show that it takes only 53 minutes to cover the distance. A flow of 25 cfs was recorded at the spring on two occasions, and solution chemistry suggests that 4–5 ppm of limestone are dissolved in the underground passage of the water.—ESL

01635 **Ford, J. P.** Cincinnatian geology in southwest Hamilton County, Ohio: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 6, pt. 1, p. 918–936, illus., 1967.

Cincinnatian rock units in southwestern Ohio are distinguished by their bulk lithologic characteristics, and several stratigraphic units are named or redefined. Shale and limestone strata commonly grade into or intertongue with each other. Directions of regional dip and intertonguing correspond. Ten limestone classes express the differences in sedimentary history and depositional environment. Most limestone deposition occurred in a high-energy environment.—WLA

01834 **Fortescue, J. A. C.; Hornbrook, E. H. W.** Progress report on biogeochemical research at the Geological Survey of Canada, 1963–1966: Canada Geol. Survey Paper 67-23, pt. 1, 143 p., illus., tables, 1967.

The research described in this report follows the pioneer lead of Dr. H. V. Warren and co-workers at the University of British Columbia. The report is in four parts, the first of which provides five summaries of basic concepts as background information; the second describes a movable spectrograph laboratory unit; the third deals with methods of selection of field areas, collection of rock surficial material, soil and vegetation samples, their processing and chemical analysis, and mechanical methods for plotting results. The fourth part describes four feasibility experiments carried out in a biogeochemical research greenhouse, with a contribution by R. K.

Wanless dealing with the uptake of strontium and lead by willow cuttings to explore the use of non-radioactive isotopic tracers.—GDC

01851 **Franklin, George J.** Geologic map of the Coiltown quadrangle, Hopkins County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-629, scale 1:24,000, section, text, 1967.

Coal has been mined extensively in the Coiltown quadrangle; in 1965 it was being mined at two locations, one strip and one underground. In some localities, coal adjacent to faults has been disturbed to the extent that it was not mined; in other localities mining has been carried out across faults both on the surface and below ground. The Kirkwood Springs gas field was discovered in 1929 on the upthrown side of the Beulah fault in the Late Mississippian Palestine Sandstone and has been used for gas storage since 1954. In 1964 a gas well was tested at a rate of 5 million cubic feet per day. The Providence Limestone Member of the Lisman Formation has had limited use as road metal.—MCM

01753 **Frarey, M. J.** Willbob Lake and Thompson Lake map-areas, Quebec and Newfoundland (23 0/1 and 0/8) [with French abs.]: Canada Geol. Survey Mem. 348, 73 p., illus., tables, geol. maps, 1967.

Bedrocks of these contiguous areas along the east side of the Labrador Trough are Precambrian, probably Proterozoic in age. Strata of the Knob Lake and Doublet Groups and the more metamorphosed Laporte rocks in fault contact to the northeast are described; basic sills intrude the whole sequence. Metamorphism ranges erratically from negligible to greenschist levels, best developed in pyroclastic rocks near the Walsh Lake fault. Structures in northeastward order are: a generally homoclinal, northeast-dipping block; a central block of southeast-plunging folds and several strike faults and shear zones; and the metamorphic Laporte block. Major deformation is laid to the Hudsonian orogeny. Sulfide mineralization is common, particularly in dark shales and gabbroic rocks, but no workable deposits have been discovered.—GDC

01759 **Frarey, M. J.** Geology, Thompson Lake, Quebec: Canada Geol. Survey Map 1183A (also in Mem. 348), scale 1:63,360, 1967.

01760 **Frarey, M. J.** Geology, Willbob Lake, Quebec-Newfoundland: Canada Geol. Survey Map 1184A (also in Mem. 348), scale 1:63,360, 1967.

01779 **Frebold, Hans; Mountjoy, Eric W.; Tempelman-Kluit, D. J.** New occurrences of Jurassic rocks and fossils in central and northern Yukon Territory: Canada Geol. Survey Paper 67-12, 35 p., illus., tables, 1967.

This report presents new information on the stratigraphy of marine Jurassic rocks in parts of central and northern Yukon. The presence of these rocks indicates that the Jurassic sea that invaded northern Yukon and northern Alaska extended at least temporarily into the Keele Range and Charley River area, and covered regions that hitherto had been considered to be land during Jurassic times. A southward temporary extension of this Arctic transgression to the sea in southern Alaska is considered possible. The report contains systematic descriptions of many of the more important guide fossils and a discussion of age and correlation based on the ammonite faunas.—Authors' abstract

01896 **Fredskild, Bent.** Palaeobotanical investigations at Sermermiut, Jakobshavn, West Greenland: Medd. om Gronland, v. 178, no. 4, 54 p., illus., tables, 1967.

Two transects in a bog were investigated, pollen diagrams from three profiles worked out, a series of macrofossil samples examined, and samples from one profile were dated by the radiocarbon method [1560 B.C. to A.D. 400]. Data were compared with comprehensive reference material of recent pollen from Greenland. The most important feature is the twice occurring change from a dwarf shrub heath to a *Sphagnum* bog. The radiocarbon datings of these events show close agreement with the re-growth of the European raised bogs at about 700-500 B.C. and A.D. 400 respectively.—ESL

01501 **Freeman, Bob.** Burnell Field, Karnes and Bee Counties, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 35–42, illus., tables, 1967.

Freers, Theodore F. *See* Clayton, Lee. 01638

Freers, Theodore F. *See* Friends of the Pleistocene, Midwest. 01643

01483 **Freeze, R. Allan; Witherspoon, P. A.** Theoretical analysis of regional groundwater flow—[Pt.] 2, Effect of water-table configuration and subsurface permeability variation: Water Resources Research, v. 3, no. 2, p. 623–634, illus., 1967.

Details of steady-state flow in regional groundwater basins can be investigated using digital computer solutions of mathematical models. Factors considered are: ratio of depth to lateral extent of the basin, water-table configuration, and stratigraphy and subsurface variations in permeability. Results provide a theoretical basis for the following properties of regional flow systems: groundwater discharge will tend to be concentrated in major valleys, recharge areas are invariably larger than discharge areas, in hummocky terrain numerous sub-basins are superposed on the regional system, buried aquifers tend to concentrate flow toward principal discharge area, and stratigraphic discontinuities can lead to distributions of recharge and discharge areas that are largely independent of water-table configuration.—*from* Authors' abstract

Frey, Fred A. *See* Haskin, Larry A. 11057

01464 **Friedman, Bob.** FISH charts ocean floor: Sea Frontiers, v. 13, no. 2, p. 98–101, illus., 1967.

A new electronic sea-floor mapping instrument is described using upward-, downward-, and side-looking sonar, and a proton magnetometer. FISH can measure detailed structures; a canyon a tenth of a mile wide and 150 feet deep, north of Hawaii, was observed over a long distance.—ESL

Friedman, I. I. *See* Murata, K. J. 01476

01380 **Friedman, Irving; Redfield, Alfred C.** Application of deuterium analyses to the hydrology of the lakes of the Grand Coulee, Washington [summ.], *in* Isotope techniques in the hydrologic cycle—Symposium, Univ. Illinois, 1965: Am. Geophys. Union Geophys. Mon. Ser., no. 11, p. 77–80, illus., 1967.

Friedman, Irving. *See* Hanshaw, Bruce B. 01383

01440 **Friend, P. F.** The growth of the North Atlantic Ocean by the spreading of its floor: Polar Rec., v. 13, no. 86, p. 579–588, illus., 1967.

Structural and sedimentation evidence in the North Atlantic region is in accord with a progressive opening of the North Atlantic during the last 1–200 m.y. Paleomagnetic studies support a systematic westward displacement of 20° to 30° of pre-150 m.y. old rocks of America relative to Europe. Geophysical studies since 1950 of ocean floors have led to support for the drift theory in the discovery of the symmetry, width, and size of magnetic anomalies on the two flanks of the rise-ridge system and in the independent records of recent magnetic field reversals. The irregularity of reversal history preserved in dated cores implies a relatively constant rate of spreading in the last 10 m.y. The implications of acceptance of some degree of continental drift for geological research in the Arctic and North Atlantic regions are examined.—VSN

01643 **Friends of the Pleistocene, Midwest; Clayton, Lee; Freers, Theodore F.** (editors). Glacial geology of the Missouri Coteau, guidebook, May 1967: North Dakota Geol. Survey Misc. Ser. 30, 170 p., illus., 1967.

This guidebook consists of a roadlog for a field trip between Jamestown and Bismarck, and a number of short papers (cited separately) on various aspects of

Pleistocene geology of the Missouri Coteau in North Dakota. The subjects of the papers include glacial features, deposits, lake development, drainage systems, ground water, paleontology, and paleoecology.—LLP

01644 **Fuloria, R. C.** Source rocks and criteria for their recognition: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 6, pt. 1, p. 842–848, illus., 1967.

A greater quantity of oil fraction in the chloroform bitumen, together with a comparatively smaller quantity of chloroform bitumen in the organic matter, serves as positive criterion for considering the sediments as better source rocks. Additional conclusions are: (1) the presence of numerous hydrocarbon accumulations, particularly of oil, in wholly lithologic traps is a positive criterion in the recognition of source rocks; (2) high content of organic nitrogen in sediments is a positive criterion for source rocks; whereas (3) high content of humic acid is a negative criterion; (4) relatively higher specific gravity and increased content of higher molecular-weight paraffins and heavier higher-boiling-point fractions in oils suggest that the oil deposit is nearer its source rock; and (5) plant matter is of great importance as a source of hydrocarbons.—*from* Author's abstract

01809 **Furumoto, Augustine S.** A study of the source mechanism of the Alaska earthquake and tsunami of March 27, 1964—Pt. 2, Analysis of Rayleigh wave: Pacific Sci., v. 21, no. 3, p. 311–316, illus., 1967.

The source mechanism of the earthquake has been investigated by analyzing the Rayleigh wave recorded on the strain seismograph at Kipapa Station, Hawaii. The parameters that give the best fit to the observed data are: rupture length of 800 km, rupture velocity of 3 kmps, and direction of rupture line of S. 30° W. The results of this analysis compare favorably with field data of elevation changes, distribution of epicenters of aftershocks, and area of generation of the tsunami as obtained from sea-wave refraction diagrams.—*from* Author's abstract

01561 **Fuzesy, L. M.** Geology of the Frobisher–Alida Beds, southeastern Saskatchewan: Saskatchewan Dept. Mineral Resources Rept. 104, 59 p., illus., tables, geol. maps, 1966 [1967].

On the northern flank of the Williston Basin the Middle Mississippian Frobisher–Alida subcrop occurs as truncated, southerly dipping beds that are some 4,100 feet below the surface and average 370 feet in thickness. They are divided into three units—the carbonate Alida and Frobisher Beds separated by the thin Kisbey Sandstone; oil is produced from all three. The major sedimentary environments were open marine shelf, barrier bank, and lagoonal. A new carbonate classification of 10 rock groups is proposed; its parameters are grain type, relative proportion of grain and matrix, diagenetic textural features, and effective porosity. Core descriptions are given in an appendix, and erosion surface maps and cross-sections in pocket.—GDC

01511 **Gallagher, Ronald P.** Comments on a paper by Kenneth Medearis, "Coupled bending and torsional oscillations of a modern skyscraper" [1966]: Seismol. Soc. America Bull., v. 57, no. 2, p. 297–299, illus., 1967.

One significant factor, soil effects, has not been considered by Medearis in the paper in question (ibid., v. 56, no. 4, p. 937–946, 1966) in evaluating mode shapes and frequencies. A more complete scheme idealizing the modern skyscraper and its foundation for structure-soil interaction is offered. It is also suggested that the program could be altered to incorporate the vertical, horizontal, and rotative stiffness of footings, caissons, or pile groups beneath the columnar bases, as well as stiffnesses for each floor.—DBV

11055 **Gammon, John B.** Some observations on minerals in the system CoAsS–FeAsS: Norsk Geol. Tidsskr., v. 46, no. 4, p. 405–426, illus., tables, 1966.

An X-ray and optical investigation of cobaltite, glaucodot, and arsenopyrite from the Modum district, Norway, has disclosed that naturally occurring cobaltites have either ordered or disordered crystal structures. The presence of ordered cobaltite may be a useful indicator of metamorphism in ore deposits. It is predicted that

a similarly disordered structure is possible in arsenopyrite. By X-ray determination of cobalt content of arsenopyrite, it is shown that when cobalt is present in excess of nine percent, glaucodot may appear as a separate mineral phase. High cobaltian glaucodot could be a polymorphic form of cobaltite. The varietal names, danaite and alloclasite, are thought to be unnecessary and should be replaced by "cobaltian arsenopyrite" and "high-cobaltian glaucodot", respectively.—*from* Author's abstract

01772 **Garman, R. Keith; Milici, Robert C.** Geologic map of the Brockdell quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 103-SE [sheet 1], scale 1:24,000, section, separate text, 1967.

Two maps of the coal seams in the Brockdell quadrangle by Garman are cited separately. The text, "Mineral resources summary of the Brockdell quadrangle, Tennessee," describes the coal, dimension sandstone, and limestone produced in the area. Coal-bearing strata are the Pennsylvanian lower Pottsville Series, of which only the Sewanee and Morgan Springs beds have been mined extensively; estimated reserves for them and the Lantana seam total 9,488,300 tons in beds more than 28 inches thick. There are five abandoned (dimension) sandstone quarries in the Rockcastle Conglomerate. A limited number of rock formations containing limestone are present in a small area. Potential resources are sand, chert, and shale.—MCM

01773 **Garman, R. Keith.** Coal map of the Lantana seam; coal map of the Morgan Springs, Sewanee, Wilder, and Bon Air seams, with data on the Richland and Lower Wilder seams, Brockdell quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 103-SE [sheets 2-3], scale 1:24,000, separate text, 1967.

The accompanying text, "Mineral resources summary of the Brockdell quadrangle, Tennessee," by Garman and Milici is cited separately.—MCM

11073 **Garner, H. F.** Groundwater aquifer patterns and valley alluviation along Mountain Fork Creek, Crawford County, Arkansas: Arkansas Acad. Sci. Proc., v. 20, p. 95-103, illus., 1966.

Six resistivity cross-valley traverses, supplemented by auger boring, show a near-surface layer of silty loam, coarse alluvial gravel layers, and bedrock composed of silty shale, siltstones, calcareous sandstones, and limestones. Detritus sheathing pediment slopes is thin and generally impervious. Most valley flats were buried with this detritus, but where they are reworked, contain chert clasts, many rounded pebbles, and very little silt. Chert also occurs in swales where flood overflow sweeps across the fill. Fluvial history includes: erosion of a narrow v-shaped valley exposing a chert inlier; localized fluvial activity coinciding with development of valley flats and pediments; through-flowing water sweeping the alluviated surface, re-exposing the chert; through-flowing channel-confined runoff; and subsequent incision. Possible aquifers are channel fills downstream from sharp bends or on the concave side of large bends.—ESL

Garrison, Louis E. *See* McMaster, Robert L. 01700

Gault, D. E. *See* Chapman, D. R. 01641

Gemeinhardt, John P., Jr. *See* Esrig, Melvin I. 01864

01409 **Gentile, Richard Joseph.** Stratigraphy, sedimentation and structure of the upper Cherokee and lower Marmaton (Pennsylvanian) rocks of Bates County, and portions of Henry and Vernon Counties, Missouri [abs.]: Dissert. Abs., Sec. B., Sci. and Eng., v. 27, no. 9, p. 3148B, 1967.

01866 **Geological Society of Sacramento; Shlemon, Roy J.** Quaternary geology of northern Sacramento County, California—Annual field trip guidebook of the Geological Society of Sacramento, May 1967: Davis, Calif., Univ. California, Dept. Geology, 60 p., illus., tables, geol. map, 1967.

Urbanization in this valley area has provided numerous man-made exposures and data from water well logs and bridge test boring for reconstruction of the local geomorphic history. Soils have been useful for analyzing the Quaternary history; their relationship to specific landforms and geologic formations is summarized in a table and a block diagram. The geologic formations are listed and shown on a map, and correlations are given with other areas. In three of the four recognized terraces of the American River, the gravels can be traced as ancestral channels. Depositional episodes are related to Pleistocene climatic change, and some landforms to regional tectonics. Thickness and lithology are described in the road log and structure sections.—GDC

George, Warren. *See* Long, Erwin. 01861

George, Warren. *See* Long, Erwin. 01882

George, Warren. *See* Hansen, Wallace R. 11108

Ghose, Subrata. *See* Evans, B. J. 01697

01410 **Gibson, David Whiteoak.** Triassic stratigraphy and petrology between the Athabasca and Smoky Rivers of Alberta [abs.]: Dissert. Abs., Sec. B., Sci. and Eng., v. 27, no. 9, p. 3148B–3149B, 1967.

01492 **Gibson, Thomas G.** Stratigraphy and paleoenvironment of the phosphatic Miocene strata of North Carolina: Geol. Soc. America Bull., v. 78, no. 5, p. 631–649, illus., table, 1967.

Lithologic and faunal content of the phosphatic Pungo River Formation and the overlying Yorktown Formation provide evidence of the optimum depositional sites for primary phosporite. The foraminifers and mollusks are interpreted as indicating a paleoenvironment of cool-temperate waters 100 to 200 m deep during most of Yorktown time, but the waters gradually shallowed until depths of less than 15 m (and probably brackish conditions) were reached in latest Yorktown time. Cool-temperate waters during early Yorktown time became warm-temperate to subtropical in later Yorktown time. The faunal communities suggest that circulation patterns of ocean currents during Pungo River time were different from those at present but changed during late Yorktown time to present patterns.—HCW

Glenn, Jerry L. *See* Prych, Edmund A. 01901

01542 **Glennie, James S.** The ACFM projection—A potentially useful tool in mineral equilibrium studies [abs.], *in* New York State Geol. Assoc., Guide book to field trips, 39th Ann. Mtg., New Paltz, N. Y., 1967: New York, City Coll. City Univ. New York, Dept. Geology, p. TK3, 1967.

01663 **Glover, E. D.; Sippel, R. F.** Synthesis of magnesium calcites: Geochim. et Cosmochim. Acta, v. 31, no. 4, p. 603–613, illus., table, 1967.

Ca–Mg carbonates have been synthesized at temperatures in the range of the natural processes (about 0–40°C). The chemical parameters differed from the natural only in one major respect—the total carbonate concentration is much higher in the preparations used. It is possible that higher pH values and lower carbonate concentrations in nature may lead to the same reactions. The longer time available in the natural situation may make the difference between order and disorder. The fact that disordered forms are easily precipitated fits well with Peterson's (1966) idea that disordered Ca,Mg carbonates first precipitate, then order to dolomite by diffusion.—DBV

Godfrey, John D. *See* Baadsgaard, H. 01425

Goldberg, M. C. *See* Wershaw, R. L. 01391

01855 **Goldsmith, Richard.** Bedrock geologic map of the Montville quadrangle, New London County, Connecticut: U.S. Geol. Survey Geol. Quad. Map GQ-609, scale 1:24,000, sections, 1967.

01584 **Goodwin, Jonathan H.; Surdam, Ronald C.** Zeolitization of tuffaceous rocks of the Green River Formation, Wyoming: Science, v. 157, no. 3786, p. 307–308, illus., 1967.

The alkali-rich zeolites mordenite and clinoptilolite have been discovered in tuffaceous rocks of the Green River Formation, Wyoming. This occurrence strongly supports the alteration of glass to alkali-rich zeolite to analcime as the paragenetic sequence of alteration of tuffaceous rocks deposited in ancient Lake Gosiute. Authors' abstract

Gordon, Bernard B. *See* Jansen, Robert B. 01886

Gordon, J. E. *See* Buie, Jeff C. 01500

01454 **Gould, Stephen Jay.** Evolutionary patterns in pelycosaurian reptiles—A factor-analytic study: Evolution, v. 21, no. 2, p. 385–401, illus., tables, 1967.

The multivariate technique of factor analysis is reviewed as a scheme into which thousands of individual facts can be synthesized to provide casusal insights. In the oblique solution used here, samples (species) are treated in Q-mode analysis, variables (bone measures in 29 species) in the R-mode. Cranial and postcranial data supplied by Romer and Price are used. In the cranial R-mode study, facial length proved a key criterion of adaptive radiation; in postcranial R-mode, bone lengths sort into a grouping with body length, but widths group with body weight; in cranial Q-mode, advanced carnivorous sphenacodonts and ophiacodonts concentrate around one axis and herbivorous edaphosaurs around another and in postcranial Q-mode, semi-aquatic ophiacodonts sort with one trend in locomotor adaptation and terrestrial sphenacodonts and edaphosaurs with the other. Primitive forms group about their own reference axis.—ESL

Gower, H. D. *See* Vedder, J. G. 01856

01824 **Graham, Richard E.** The subterranean niche of *Pseudometa biologica* (Arachnida; Araneidae) in the Santa Cruz caves, California, with comments on ecological equivalence in the cave environment: Caves and Karst, v. 9, no. 3, p. 17–22, illus., 1967.

The spider, *Pseudometa biologica*, of the Santa Cruz Cave fauna, which resembles the *Meta menardi* spider, is a major predator of flying and hopping insects of the cave Twilight Zone. The Empire Cave, in particular, was studied to determine population differences before and after the cave was partly closed in 1962. The niche is recommended as a fundamental unit for analyzing the cave community as a means of determining ecological equivalence and possible similarity in community dynamics. The confined spaces of caves with their variable surface conditions and interior environment are ideally suited for hypervolume determination. The summation of all cave-adapted niches and the activities within them with respect to physical surroundings is a sound basis for studying cave communities.—LLP

01731 **Granger, Steuben G.** Subsoils and foundation design in Richmond, Va.—Discussion [of paper 4915 by L. Casagrande, 1966]: Am. Soc. Civil Engineers Proc., v. 93, paper 5215, Jour. Soil Mechanics and Found. Div., no. SM 3, p. 172–173, 1967.

Field observations of a sampler in clay and sand-clay strata involved plugging of the drill rods, bowing of the sampler, and a "squeezing in" effect of the strata. Questions raised in connection with Casagrande's paper (ibid., v. 92, no. SM 5, p. 109–126, 1966) concerned the possibility of the strata being more than just preconsolidated, or of some form of pressure build-up from organic decomposition.—LLP

11091 **Gray, Dwight E.; Coutts, John W.** Man and his physical world (4th edition): Princeton, N. J., D. Van Nostrand Co., 664 p., illus., tables, 1966; originally published 1942.

The textbook is directed to students in introductory college courses in the physical sciences. A substantial amount of material has been added in this edition and the chapter on heat engines has been omitted as being too specific. After an introductory chapter discussing the scientific method and its historical development, the book is divided into four sections: man and the universe, man and his earth, man and energy, and man and materials. The second section covers the beginnings of geologic science, the Earth's changing surface, clues to Earth history, and geologic history; the third includes some geophysics; and the fourth, on chemistry, includes a section on hydrocarbons and some geochemistry.—ESL

01411 **Greeley, Ronald.** Cenozoic and Recent lunulitiform bryozoans of the Gulf and Atlantic Coasts [abs.]: Dissert. Abs., Sec. B., Sci. and Eng., v. 27, no. 9, p. 3149B, 1967.

01662 **Greenwood, H. J.** The N-dimensional tie-line problem: Geochim. et Cosmochim. Acta, v. 31, no. 4, p. 465-490, illus., tables, 1967.

An analytical method is presented for determining whether two mineral assemblages can be related to one another by a balanced chemical reaction, or whether their differing mineralogies must be attributed to differing bulk compositions. Projections and other chemographic methods are equivalent but less general than the proposed method. Set theory and vector algebra are used to state the problem and formulate a solution. Solutions are reached by methods of linear programming and result in balanced equations, if such exist. Open and closed systems can be equally well treated. Idealized and natural examples are given.—DBV

01880 **Gresens, Randall L.** Composition-volume relationships of metasomatism: Chem. Geology, v. 2, no. 1, p. 47-65, illus., tables, 1967.

Equations are derived for calculations of gains and losses in metasomatic alterations in terms of known chemical analyses and specific gravities of unaltered and metasomatized rocks or minerals. It is not necessary to calculate structural formulas for minerals nor to have complete chemical analyses. However, for rigorous treatment, it is best to know standard deviations for each element in an analysis and to carry these values through the calculations. Trace elements should be evaluated in terms of composition-volume relations because when released, they are potential ore sources.—VSN

01629 **Gribbon, P. W. F.** Glaciological notes from Sukkertoppen, West Greenland: Jour. Glaciology, v. 6, no. 47, p. 752-753, 1967.

The retreat of a glacier front at Sukkertoppen, West Greenland, has been related by lichen size measurements to the lowering of the snow level in the accumulation region of the glacier. The altitudes of two Quaternary marine shell beds near Sukkertoppen have been measured and the shell fauna contained in them has been identified. The behaviour of two adjacent ice-dammed lakes is also discussed.—Author's abstract

11109 **Grönhagen, Doris; Luterbacher, Hanspeter.** Beobachtungen an den Foraminiferen-Gattungen *Pseudotextulariella* und *Textulariella* sowie verwandten Formen [with English abs.]: Eclogae Geol. Helvetiae, v. 59, no. 1, p. 235-246, illus., 1966.

Internal structures of *Pseudotextulariella*, *Textulariella*, and related forms are discussed. Neogene and Recent *Textulariella* have an alveolar structure similar to that of *Cyclammina*. Late Tertiary forms described as *"Cuneolina"* are considered as flattened *Textulariella*. Textulariellidae, n. fam., is proposed to include genera with trochospiral early coil and alveolar internal structure. The reclassification involved *Textularia barrettii* Jones and Parker, 1876, Recent, Florida, as type species of type genus *Textulariella; "Cuneolinella" lewisi* Cushman and Bermudez, 1941, which should probably be referred to *Textulariella*; other genera assigned to the family, *Guppyella*, *Alveovalvulina*, and *Alveovalvulinella*, which include Cenozoic species common in the West Indies.—VMJ

01858 **Guillet, G. R.** The clay products industry of Ontario: Ontario Dept. Mines Indus. Mineral Rept. 22, 206 p., illus., tables, geol. maps, 1967.

Since World War II, there has been a ten-fold increase in value of clay products. Following a slight decline after the peak in 1958, a record value of 23,723,602 dollars was reached in 1964. Shales of the Queenston and Dundas Formations (Ordovician), important brick materials, are exposed near Toronto and Hamilton; shale of the Hamilton Formation (Devonian) is used for brick and tile in southwestern Ontario. Clays, practically all Pleistocene or Recent, are closely related to glacial events, and reflect their bedrock source. Due to prevalent Paleozoic limestones in southern Ontario, most of the clays are calcareous; those derived from Precambrian rocks are commonly red-burning. Lithology and composition of the shales, and glacial history and brief descriptions of the clay deposits are presented. Two geologic maps, in pocket, show principal clay and shale areas.—GDC

01690 **Haas, Otto.** Recent literature on Mesozoic ammonites, Pt. 8: Jour. Paleontology, v. 41, no. 3, p. 726–741, 1967.

Nearly 100 papers are reviewed in this part of the essay-review of Mesozoic ammonite literature (Cephalopoda, Ammonoidea), which is divided into four sections: General, Triassic, Jurassic, and Cretaceous. Proposals for 29 new genera and 8 new subgenera, and a new superfamilial classification for Jurrasic and Cretaceous ammonoids, are included.—JP

01412 **Haenggi, Walter Tiffany.** Geology of El Cuervo area, northeastern Chihuahua, Mexico [abs.]: Dissert. Abs., Sec. B., Sci. and Eng., v. 27, no. 9, p. 3149B–3150B, 1967.

Hafner, Stefan. *See* Evans, B. J. 01697

01374 **Hall, Clarence A., Jr.; Corbató, Charles E.** Stratigraphy and structure of Mesozoic and Cenozoic rocks, Nipomo quadrangle, southern Coast Ranges, California: Geol. Soc. America Bull., v. 78, no. 5, p. 559–582, illus., geol. map, 1967.

Lower Cretaceous Jollo Formation and Jurassic Franciscan Group are unconformably overlain by Upper Cretaceous sedimentary rocks which in turn are unconformably overlain by a maximum thickness of 18,000 feet of upper Oligocene, Miocene, and lower Pliocene marine shales, siltstones, and sandstones, containing volcanic rocks in the lower third of the Tertiary section. Major folding, the Huasna syncline, and faulting, Huasna and Nacimiento faults, are conspicuous but the sense of fault movements is uncertain due to the long and complex histories.—AG

01715 **Hamilton, Thomas M.** Late-Recent alluvium in western North Dakota, *in* Glacial geology of the Missouri Coteau—Midwest Friends of the Pleistocene, Field Conf. 1967, Guidebook: North Dakota Geol. Survey Misc. Ser. 30, p. 151–158, illus., 1967.

The late-Recent alluvium of western North Dakota can be divided into five individual units, two of which are paleosols. By C-14 dating and tree age estimates it was established that the upper 15–20 feet of the sediment was probably deposited between 1775 and 1936. The age of the alluvium makes possible a tentative correlation with similar alluvial units studied in Wyoming and Nebraska. The periods of valley filling are associated with periods of sub-normal precipitation which decreased the slope cover, thereby increasing the sediment yield to the basins. Modern precipitation records indicate that such a period occurred from 1920 to 1936 during which time the upper unit was deposited.—Author's summary

01775 **Hamilton, Warren; Myers, W. Bradley.** The nature of batholiths: U.S. Geol. Survey Prof. Paper 554-C, p. C1–C30, illus., 1967.

A survey of major batholiths and volcanic terranes in the United States indicates that batholiths are thin, have spread out laterally at shallow depth, and that many of them reach surface and crystallize beneath a cover of their own volcanic ejecta. Batholiths intruded into miogeosynclines, platform sediments, and Precambrian

plutonic basement rocks render the tectogene hypothesis unnecessary to explain similar batholiths in eugeosynclines. Strontium isotope data indicate that granitic magmas are melted from rocks poorer in rubidium than are exposed basement rocks, and are thus derived from the lower crust or upper mantle or from volcanic materials derived in turn from such sources. Deformation attributed to crustal compression or gravity sliding may be due to rising batholith magmas. Batholiths greatly influence subsequent deformation of their regions.—BSH

01761 **Hansen, Dan E.** Geology and ground water resources, Divide County, North Dakota—Pt. 1, Geology: North Dakota Geol. Survey Bull. 45, pt. 1 (North Dakota Water Comm. County Ground Water Studies 6), 90 p., illus., tables, geol. map, 1967.

Divide County is underlain by 11,500–13,600 feet of Paleozoic, Mesozoic, and Cenozoic rocks that dip south toward the center of the Williston basin. Late Tertiary–Quaternary topography was formed by two major drainage systems of the northeastward flowing preglacial Missouri and Yellowstone Rivers. Glacial drift probably consists of four or five drift sheets, up to 638 feet thick in buried preglacial valleys but averaging about 175 feet. Glacial landforms were deposited in four phases during the northeastward recession of the Late Wisconsin glacier terminus. Mineral (or potential) resources are petroleum, lignite, clay, sand and gravel, sodium sulfate, sodium chloride, and possibly potassium chloride. The only exploited resource is petroleum produced from fragmental limestone beds of the Mississippian Madison, 6,377–7,956 feet below surface; large areas are virtually unexplored.—*from* Author's abstract

11108 **Hansen, Wallace R.; Eckel, Edwin B.; Schaem, William E.; Lyle, Robert E.; George, Warren; Chance, Genie.** The Alaska earthquake, March 27, 1964—Field investigations and reconstruction effort: U.S. Geol. Survey Prof. Paper 541, 111 p., illus., tables, 1966.

The violent earthquake of March 27, 1964 was responsible for the deaths of 114 people in Alaska and for extensive land damage covering an area of about 50,000 sq mi. Seismic sea waves that swept the Pacific Ocean caused extensive damage not only in Alaska, but in parts of California and British Columbia; unusually large waves, probably seiches, were reported in the Gulf of Mexico. In addition to a discussion of the setting and various effects of the Alaska earthquake, investigations by the U.S. Geological Survey, work of scientific and engineering task forces and reconstruction engineers are presented.—LLP

01383 **Hanshaw, Bruce B.; Rubin, Meyer; Back, William; Friedman, Irving.** Radiocarbon determinations applied to groundwater hydrology [summ.], *in* Isotope techniques in the hydrologic cycle—Symposium, Univ. Illinois, 1965: Am. Geophys. Union Geophys. Mon. Ser., no. 11, p. 117–118, 1967.

01482 **Hantush, Mahdi S.** Flow of groundwater in relatively thick leaky aquifers: Water Resources Research, v. 3, no. 2, p. 583–590, illus., 1967.

The effect of leakage on flow in aquifers is incorporated in a differential equation rather than expressed as a boundary condition as it actually occurs in the physical system. Such an approximation is justified when the main aquifer is thin, but in thicker aquifers, the use of available solutions may yield poor results. Solutions are developed by using the usual differential equation of groundwater motion and its pertinent initial and boundary conditions, expressing the effect of leakage on the flow as a boundary condition. A quantitative criterion is established for the applicability of solutions that are already available from the approximate theory now in use. The available solutions appear to be applicable wherever $b/B<0.10$, where b is the thickness of the main aquifer and B is the leakage factor.—*from* Author's abstract

01436 **Hargraves, R. B.; Burt, D. M.** Paleomagnetism of the Allard Lake anorthosite suite: Canadian Jour. Earth Sci., v. 4, no. 3, p. 357–369, illus., tables, 1967.

Analysis of paleomagnetic data on 112 samples of Precambrian anorthosite, norite, pyroxene–syenite, and hemo–ilmenite ore from four main localities in the Allard

Lake area reveals: (1) A relatively soft magnetic component resides in magnetite; the magnetite remanent magnetic vector is of normal polarity. (2) Disregarding polarity, the stable remanent magnetic vector has similar orientation in all rock types from all four localities. Either no polar wandering occurred during the emplacement and cooling of the entire igneous rock suite, or all these rock types acquired their magnetism simultaneously during subsequent metamorphism. (3) On the centered-axial-dipole model for the Earth's magnetic field, the remanent vector in the rocks gives a pole southeast of Newfoundland, at coordinates 38°36′ N., 39°36′ W.—*from* Authors' abstract

Harleman, Donald R. F. *See* Shamir, Uri Y. 01393

11053 **Harris, Ian McK.** Geology of the Cobbs Arm area, New World Island, Newfoundland: Newfoundland and Labrador Mineral Resources Div. Bull. 37, 38 p., illus., table, geol. map, 1966.

Ordovician rocks of the area are intermediate and basic volcanic flows, massive, crystalline limestone, and black argillite. Minor pyroclastics, limestone, and black argillite interbedded in the flows contain Middle Ordovician fossils. Grey-green and silty argillites with Early Silurian fossils disconformably overlie the black argillite, followed by interlayered terrigenous conglomerate, greywacke, sandstone, siltstone, and argillite of Silurian age. A recumbent fold-system was overthrust into the map area from the southeast. Normal faulting produced a graben which forms a structural belt in the central part. High-angle, transcurrent, transverse faults are numerous, and rotational and normal transverse faults are present. Ordovician limestone is quarried commercially at Cobbs Arm; estimated recoverable, high calcium limestone reserves are one million tons.—*from* Author's abstract

01587 **Harris, Stuart A.** Origin of part of the Guelph drumlin field and the Galt and Paris moraines, Ontario—A reinterpretation [with French abs.]: Canadian Geographer, v. 11, no. 1, p. 16–34, 65, illus., tables, 1967.

Existing hypotheses of glacial history do not explain field observations between Waterloo and Hamilton, Ontario. Detailed field and laboratory studies show that the Wentworth till is capable of subdivision into three distinct tills—Flamborough, Bamberg, and Parkhill—in order of decreasing age; their lithology and fabrics are described and diagrammed. The Galt sandy loam paleosol may be Port Talbot in age, or a Sangamon soil. The Guelph and Carlisle drumlins have axes parallel to fabrics of the Port Stanley till, not the Parkhill. The Moffat moraine consists of Canning till and may be a recessional moraine. Cores of the Breslau, Galt, and Paris moraines are hummocky kame gravel, with Flamborough till above; these gravels seem to be Canning ice-stagnation deposits.—ESL

01505 **Harrison, Hubert J.** Encino Field, San Patricio and Refugio Counties, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 59–63, illus., tables, 1967.

01625 **Harrison, Hubert J.** Holdsworth Field, Zavala County, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 76–79, illus., tables, 1967.

01822 **Harrison, Samuel S.** Low-cost flume construction: Jour. Geol. Education, v. 15, no. 3, p. 105–108, illus., 1967.

A flume capable of demonstrating such phenomena as sediment transport, velocity, flow, bedding, or deposition, can be built for less than five hundred dollars. The design and necessary apparatus for building such a flume, and special considerations and cautions are presented.—LLP

01585 **Harshbarger, J. W.; Evans, D. D.** Educational progress in water resources, present and future: Water Resources Bull., v. 3, no. 1, p. 29–44, illus., 1967.

The breadth of knowledge encompassed in understanding and solving complex water problems is greater than in any other field of study. Concern about the status of educational efforts and kinds of training available in 1960 to students interested

in water led to an Inter-University Conference on Hydrology in 1962 and organization in 1964 of a Universities Council on Water Resources, functions of which are outlined. Another impetus to expanded education was an Act of Congress to establish Water Resources Research Centers in each state, bringing about a much closer interdisciplinary working relationship. Suggestions are made for attracting talented students to undergraduate courses in hydrology as well as graduate programs. Various approaches and research trends are outlined; a selected list of courses is appended.—GDC

11090 **Hart, Earl W.** Mines and mineral resources of Monterey County, California: California Div. Mines and Geology County Rept. 5, 142 p., illus., tables, geol. map, 1966.

Typical of the southern Coast Ranges, the geology of Monterey County is structurally and stratigraphically complex. Pre-Cretaceous metamorphic rocks of the Sur Series, with Cretaceous granitic intrusions, are confined to the fault block between the San Andreas and Nacimiento-Sur zones. Franciscan and associated rocks comprise the oldest rocks of the flanking fault blocks. All three blocks are overlain by various sedimentary and some volcanic rocks laid down in Cretaceous-Quaternary Periods. More than 20 mineral commodities have been produced since 1889; the most important are oil and gas valued at 232,089,061 dollars, since 1947, virtually all from upper Miocene of the San Ardo field. Individual commodities are summarized, with discussion of significant deposits; other deposits and prospects are described briefly in tabular form.—GDC

Hartman, V. B. *See* Ellis, Willard. 01883

11057 **Haskin, Larry A.; Frey, Fred A.; Schmitt, Roman A.; Smith, Richard H.** Meteoritic, solar and terrestrial rare-earth distributions, *in* Physics and chemistry of the Earth, V. 7: London and New York, Pergamon Press, p. 167-321, illus., tables, 1966.

For purposes of this review the rare earth elements (REE) are defined as the lanthanides (Z = 57-71) and Y(Z = 39); Sc and Pm are excluded. The geochemical characteristics of the REE are summarized and procedures used for presentation of data examined. All data for two distributions being compared are presented on a single graph. Available RE abundance data up to the fall of 1965 are presented and evaluated with emphasis on correlations among meteoritic, solar, and terrestrial matter. Whole-rock distributions are stressed. It is concluded that studies of RE fractionation as an indicator of geologic processes are promising but have barely begun to be exploited. A list of over 130 references is included.—VSN

Hawkins, John O. *See* Swingle, George D. 01774

Hay, William W. *See* Dennison, John M. 01793

01647 **Hayes, Miles O.** Hurricanes as geological agents, south Texas coast: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 6, pt. 1, p. 937-942, illus., 1967.

The catastrophic hurricane Carla (1961) caused the deposition of turbidite up to 9.0 cm thick in the inner-neritic zone. It altered drastically the morphology of the barrier beach zone by formation of a hurricane beach ridge and by foredune erosion. As many as four faunal assemblages were mixed together in beach sediments. Wind-tidal flats received much washover material. Catastrophic storms are important sediment movers and displace normal sedimentary processes. Most energy is expended in present-day near-shore marine environments in a nonuniform manner as a series of minor catastrophies.—WCC

Haynes, Donald D. *See* Moore, Samuel L. 01852

01504 **Haynes, J. Don.** Big Caesar Upper Pflueger Field, Kleberg and Nueces Counties, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 22-27, illus., tables, 1967.

01675 **Hays, Walter W.; Nuttli, Otto W.; Scharon, Leroy.** Mapping gilsonite veins with the electrical resistivity method: Geophysics, v. 32, no. 2, p. 302–310, illus., 1967.

Resistivity profiles across dike-like gilsonite veins in the Uinta Basin, southeast of Vernal, Utah, show very sharp anomalies with a peak apparent resistivity value of the order of 20,000–25,000 ohm-cm. The observed profiles correlate best with a theoretical model having an infinite resistivity relative to that of the surrounding material; this suggests that the gilsonite veins, because of their extremely large resistivity and their vertical attitude, act as a vertical insulating sheet to the flow of electrical current in the ground.—DBV

Healy, M. L. *See* Joyner, Timothy. 01862

01468 **Heinrichs, Donald F.** Paleomagnetism of the Plio-Pleistocene Lousetown Formation, Virginia City, Nevada: Jour. Geophys. Research, v. 72, no. 12, p. 3277–3294, illus., tables, 1967.

The natural remanent magnetization of 61 lava flows from the Lousetown Formation was measured. Thirty-two flows have $D = 64°$, $I = -67°$ and the rest have more usual normal and reverse polarity directions with $D = 20°$, $I = +46°$. Both sets of flows have directions of magnetization that are significantly different from an axial dipole field. The first set of flows represents an intermediate direction of the geomagnetic field during a transition from reverse to normal polarity; the geomagnetic field deviated significantly from an axial dipole field within the late Pliocene.—DBV

01818 **Heise, Horst.** Log data daze now digitized: Oilweek, v. 18, no. 21, p. 10–11, 24, 27, illus., 1967.

The aims of the "well log digitization research project," are to assess the value of log data presently in data banks, decide upon best log computation and processing, and put the information into readily available visual form; also included will be certain log parameters and computed results in map form. The application of computer techniques to well-log analysis will prove valuable in one or two years when large amounts of log data have been recorded on magnetic tapes. Four stages that have been completed are: oil field computer facilities, general computer techniques, well-log analysis applications, and computer programs in abstract form.—LLP

01833 **Heiskanen, Weikko A.; Moritz, Helmut.** Physical geodesy: San Francisco, Calif., and London, W. H. Freeman and Co., 364 p., illus., tables, 1967.

This new textbook for graduate students with backgrounds in mathematics and physics is the outcome of progress in geodesy too great to incorporate in a revision of *the Earth and its gravity field* (Heiskanen and Vening Meinesz, 1958). Increase in available information required strict limitation to geodetic aspects and advances in theory necessitated increased emphasis on mathematical methods. Chapter headings are: fundamentals of potential theory, gravity field of the Earth, gravimetric methods, heights above sea level, astrogeodetic methods, gravity field outside the Earth, statistical methods in physical geodesy, modern methods for determining the figure of the Earth, and celestial methods.—GDC

01470 **Helbig, Karl.** Nicaragua—Land der Seen und Volkane: Kosmos, v. 63, no. 5, p. 205–210, illus., 1967.

In this tourist-oriented article on Nicaragua, brief descriptions are given of the landforms, especially the large western lakes and volcanic features, and of the gold and copper resources.—GDC

01653 **Hellner, E.; Schürmann, K.** Stability of metamorphic amphiboles—The tremolite-ferroactinolite series—A reply [to discussion of paper by R. F. Mueller, 1967]: Jour. Geology, v. 75, no. 3, p. 351, 1967.

In reply to Mueller (ibid., v. 75, no. 2, p. 234–236, 1967) there is an explanation of the type of experiment used and the reasons for not using the normal equilibrium

constant. The results obtained were valued under the conditions of $P_{water} = 1{,}000$ bars and $P_{carbon\ dioxide} = 50$ bars.—LLP

01730 **Henggi, Walter Tiffany.** Geology of El Cuervo area, northeastern Chihuahua, Mexico [abs.]: Houston Geol. Soc. Bull., v. 9, no. 10, p. 20–21, 1967.

01893 **Henkel, David J.** Local geology and the stability of natural slopes: Am. Soc. Civil Engineers Proc., v. 93, paper 5325, Jour. Soil Mechanics and Found. Div., no. SM 4, p. 437–446, illus., 1967.

The stability of sand and sandstone layers sandwiched between clay or clay-shale layers is considered. The stable angle of sand slopes under the action of water flowing parallel to the stratification is calculated. The equilibrium of a sloping mass of sand resting on a clay stratum is examined and related to the dip of the clay stratum, the surface slope of the sand mass, and the strength of the clay. The stability of a sandstone layer resting on a clay shale bed is also examined and the variation of the required angle of shearing resistance with distance from an exposed face is given. These theoretical studies are then related to the field behavior of layered sandy and clayey strata.—Author's abstract

01565 **Hershey, Robert E.** Mineral resources summary of the Manleyville quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 5 p., tables, 1967.

This summary, accompanying Tennessee Div. Geology Geol. Map GM 20-NW by E. E. Russell, 1967 (cited separately), describes the sand resources of the Manleyville quadrangle. Mining is restricted to the Late Cretaceous McNairy Sand which is widely exposed and attains a maximum preserved thickness of about 150 feet; the sands are generally well-sorted, micaceous, and locally contain concentrations of heavy minerals.—MCM

Hershey, Robert E. *See* Barnes, Robert H. 01567

01538 **Heyl, George R.; Salkind, Morris.** Geologic structure of the Kingston Arc of the Appalachian fold belt, *in* New York State Geol. Assoc., Guide book to field trips, 39th Ann. Mtg., New Paltz, N. Y., 1967: New York, City Coll. City Univ. New York, Dept. Geology, p. E1–E5, illus., 1967.

A field trip across the Kingston Arc near Kingston, New York, was organized to observe the structural features associated with the arc. The Kingston Arc, one of the most prominent of the Appalachians, is bowed eastward and southeastward toward the crystalline core of New England.—LLP

01532 **Higgins, G. H.; Butkovich, T. R.** Effect of water content, yield, medium, and depth of burst on cavity radii: California Univ., Livermore, Lawrence Radiation Lab. Rept. UCRL-50203, 24 p., illus., tables, 1967.

Cavities produced by nuclear explosions can be accurately described provided that water content, medium density, and explosive energy are known. The equation describes results of 46 nuclear detonations in tuff, alluvium, salt and granite to the accuracy with which the cavity radius and other variables can be determined. The adiabatic expansion coefficient depends strongly on the water content of the medium. There is no indication that cavity size depends on the strength of the rock medium in which the explosion is detonated.—*from* Authors' abstract

Higgins, G. T. *See* Brett, Robin. 01599

01845 **Hill, Harry M.** Bed forms due to a fluid stream—Closure [to discussion by D. H. I. Barr (1966) of paper 4724, 1966]: Am. Soc. Civil Engineers Proc., v. 93, paper 5304, Jour. Hydraulics Div., no. HY 4, p. 278, 1967.

Hill has chosen to use Bagnold's experiments, mentioned by Barr (ibid., v. 92, no. HY 6, p. 226–227, 1966), as a basis for correlating experiments rather than for further investigation of dispersive stress. (Original paper: ibid., v. 92, no. HY 2, p. 127–143, 1966).—LLP

01543 **Ho, Diana Yunn.** Heavy mineral size distribution in some Erie and Warren beach sands, western New York [abs.], *in* New York State Geol. Assoc., Guide book to field trips, 39th Ann. Mtg., New Paltz, N. Y., 1967: New York, City Coll. City Univ. New York, Dept. Geology, p. TK4, 1967.

Hodgson, J. H. *See* Wickens, A. J. 01534

01467 **Hohenberg, C. M.; Munk, M. N.; Reynolds, J. H.** Spallation and fissiongenic xenon and krypton from stepwise heating of the Pasamonte achondrite; the case for extinct plutonium 244 in meteorites; relative ages of chondrites and achondrites: Jour. Geophys. Research, v. 72, no. 12, p. 3139–3177, illus., tables, 1967.

Results of a series of stepwise heating experiments show that in addition to the fissiongenic xenon component discovered by Rowe and Kuroda (1965) there is an important spallation component. The isotopic compositions of the fission and spallation xenon are calculated. Krypton also shows a spallation component. The evidence on which rests the case for extinct Pu–244 in meteorites is reviewed. Reexamination of data on ordinary and carbonaceous chondrites in the light of the Pu–244 hypothesis suggests that ordinary chondrites may have cooled at least 168 m.y. earlier than achondrites and carbonaceous chondrites at least 416 m.y. earlier.—DBV

01622 **Holden, Richard N.** Kawitt (Edwards) Field, Karnes and DeWitt Counties, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 91–95, illus., tables, 1967.

Holland, H. D. *See* Rosenberg, P. E. 01671

01682 **Holman, R. H. C.; Durham, C. C.** A mobile spectrographic laboratory: Canada Geol. Survey Paper 66–35, 15 p., illus., 1967.

A mobile spectrographic laboratory mounted in a house trailer is described. The laboratory may be hauled by road to a field site and set up to provide spectrographic analyses of geological materials shortly after collection. All instruments are easily removed from the trailer at the end of a field program for installation in a permanent laboratory.—Authors' abstract

01494 **Holmes, G. T.** West Edinburg Field, Hidalgo County, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 198–206, illus., tables, 1967.

01814 **Hood, Peter J.** Geophysical surveys of the continental shelf south of Nova Scotia: Maritime Sediments, v. 3, no. 1, p. 6–11, illus., 1967; with title, Geologists probe Scotian shelf: Oilweek, v. 18, no. 20, p. 31–34, illus., 1967.

Gravity, magnetometer, and seismic surveys have been carried out on the Scotian shelf in recent years. A geologic sketch map shows bathymetry, depth to basement, and possible Triassic intrusions. Tertiary and Cretaceous strata underlie Georges Bank and outcrop along the slope; and seismic velocities indicate that the crystalline basement underlying the Bank may be granite. Cambrian–Ordovician formations parallel the coast in the north. Large granite intrusions occur below the sediments south of Halifax, and a number of faults, mostly extensions from the mainland, are shown in the same area. The greatest thickness of sedimentary rocks, 14,750 feet, occurs around Sable Island. Chedabucto Bay is underlain by Mississippian and Triassic rocks, and bordered by faults. Cretaceous–Pleistocene sediments overlie Devonian granite under Banquereau Bank.—ESL

Hornbrook, E. H. W. *See* Fortescue, J. A. C. 01834

01502 **Horton, Wayne C.; Bryant, Luther F.** Bloomington Field, Victoria County, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 30–34, illus., tables, 1967.

Hough, Van Ness D. *See* Nickelsen, Richard P. 01463

11078 **Houng, K. H.; Uehara, G.; Sherman, G. D.** On the exchange properties of allophanic clays: Pacific Sci., v. 20, no. 4, p. 507–514, illus., table, 1966.

Cation exchange in soils is considered to be an equilibrium reaction between the clay acid and the clay salt, assuming that the hydrogen-saturated and metal ion-saturated clays behave as if they were weak acid and salt, respectively. Exchange curves obtained on clay minerals, allophanic clays, soils, and on synthetic silica, aluminosilicate, and aluminum hydroxide gels are compared. It is suggested that the amount of exchangeable bases should be expressed in terms of percentage of the permanent charges, since the pH-dependent charges were considered not to take part in the exchange reaction under normal soil conditions.—*from* Authors' summary

01627 **Howard, J. H.** A classification of subsurface bodies of fragmented rocks: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 6, pt. 1, p. 945–951, illus., table, 1967.

An objective classification of subsurface bodies of fragmented rock is proposed. In crackle-mosaic bodies the rocks have been fractured, but the fragments have not been significantly displaced. In rubble-plumcake bodies, the fragments are clearly jumbled. The age of fragmented rock with respect to age of larger mapping units within which the body lies is a secondary classification.—WCC

01830 **Hoyt, John H.** Intercontinental correlation of late Pleistocene sea levels, southeastern United States of America and southern South West Africa [abs.]: Coastal Research Notes, v. 2, no. 5, p. 3, 1967.

01674 **Huang, W. H.; Johns, W. D.** The chlorine and fluorine contents of geochemical standards: Geochim. et Cosmochim. Acta, v. 31, no. 4, p. 597–602, tables, 1967.

Chlorine and fluorine analyses are reported for 22 geochemical standards, with a precision of better than five percent. Significant variations in the Cl/F ratio of various igneous rock types are noted.—Authors' abstract

Hubbell, David W. *See* Prych, Edmund A. 01901

Hughes, Jack T. *See* Dalquest, Walter W. 11068

Hurley, P. M. *See* Faure, G. 01597

11089 **Hurst, Vernon J.; Crawford, Thomas J.; Sandy, John.** Mineral resources of the Central Savannah River area, V. 1–2: Washington, D. C., U.S. Econ. Devel. Adm., V. 1, 467 p., illus., tables, 1966; V. 2, 231 p., illus., tables, 1966.

The report is based on a mineral resource survey of 5,222 sq mi and a review of water resources in east-central Georgia. Study procedures include mapping and sampling, alluvium study, and ultraviolet and geochemical investigations. Piedmont metamorphic and igneous rocks and Cretaceous and Tertiary stratigraphy are reviewed. Mineral resources are discussed in alphabetical order, with descriptions of individual prospects by county. Principal proven resources are clays, limestone, sand and gravel, kyanite, and sericite. Major developments of nickel, base-metal sulfides, and phosphate are possibilities to be evaluated. Volume 2 contains 15 appendixes covering data on clay minerals, quartz veins, and pegmatites, test hole logs in Jefferson County, and descriptions of old gold workings.—ESL

Hvorslev, Mikael J. *See* Turnbull, Willard J. 01885

Hwang, Li-San. *See* Vanoni, Vito A. 01899

01888 **Idriss, I. M.; Seed, H. Bolton.** Response of earth banks during earthquakes: Am. Soc. Civil Engineers Proc., v. 93, paper 5232, Jour. Soil Mechanics and Found. Div., no. SM 3, p. 61–82, illus., tables, 1967.

The response of earth banks during earthquakes is evaluated by the finite element method. Maximum values and time histories of the response values throughout the bank can be obtained. The method is illustrated by evaluating the response

of a clay bank on a clay foundation to both the horizontal and vertical components of a prescribed earthquake motion. Surface accelerations, stresses at selected points, and seismic coefficients for specified wedges are presented. The following are examined: the stability of the slope during the earthquake, calculated acceleration response spectra along the surface of the bank, influence of the vertical component of the earthquake, influence of material properties, and height of bank on response values.—*from* Authors' abstract

11106 **Idyll, C. P.** The Ironshore: Sea Frontiers, v. 12, no. 4, p. 328–339, illus., 1966.

In this popular article on Cayman Brac, one of the smaller islands of the block-faulted Cayman Ridge in the Caribbean Sea, the remarkable beach of the island is described. The Ironshore was formed by deposition of soft marl over the wave-cut platform at the base of a steep sea cliff of Oligocene limestone. The surface of the marl has gradually hardened to a flat, dark-gray crust, on which cobbles and boulders of coral rock are piled in high beach ridges. The waves have undercut the hard crust, forming caves and blowholes.—VMJ

11103 **Ives, J. D.** Block fields, associated weathering forms on mountain tops and the nunatak hypothesis: Geog. Annaler, v. 48A, no. 4, p. 220–223, 1966.

In this discussion of R. Dahl's 1966 paper on the block fields, weathering pits, and tor-like forms in the Narvik Mts. of Norway, the writer expresses the belief that many of the basic questions on the nunatak hypothesis cannot be fully answered now. However, it is concluded from observations in eastern arctic Canada and Scandinavia that the existence of block fields over a wide area is a good guide to the approximate upper limit of continental ice during the maximum of the last glaciation.—ESL

Jaffe, Elizabeth B. *See* Jaffe, Howard W. 01539

01539 **Jaffe, Howard W.; Jaffe, Elizabeth B.** Structure and petrology of the Precambrian allochthon and Paleozoic sediments of the Monroe area, New York, *in* New York State Geol. Assoc., Guide book to field trips, 39th Ann. Mtg., New Paltz, N. Y., 1967: New York, City Coll. City Univ. New York, Dept. Geology, p. F1–F17, illus., 1967.

This field trip of the Monroe area, New York, is concerned with observation of outcrops and explanation of the structure and petrology of the area. The rocks consist of folded and faulted autochthonous Precambrian gneisses, Lower Cambrian through Middle Devonian sediments, and allochthonous Precambrian gneisses. The proposed sequence of events that occurred in the area's complex structural history is presented.—LLP

01447 **Jakway, George E.; Clement, Jerry T.** An endocranial cast of the Miocene dog, *Tomarctus*, from the fossil beds of Barstow, California: Southern California Acad. Sci. Bull., v. 66, no. 1, p. 39–45, illus., tables, 1967.

The endocranial cast of this Miocene dog, *Tomarctus*, was recovered from unconsolidated sediments in a locality within the upper part of the type Barstow Formation. Fragments of the tympanic bullae are the only osseous remains. Compared with plaster casts of seven mongrel skulls, the shape of canid brains seems to have changed little since the late Miocene. The cerebellum is slightly more exposed dorsally in *Tomarctus* and the entire cast appears compressed dorso ventrally. An increased development of the cerebral cortex is revealed, both in height and posterior extent since the Miocene.—GDC

James, Laurence B. *See* Jansen, Robert B. 01886

01886 **Jansen, Robert B.; Dukleth, Gordon W.; Gordon, Bernard B.; James, Laurence B.; Shields, Clyde E.** Earth movements at Baldwin Hills reservoir: Am. Soc. Civil Engineers Proc., v. 93, paper 5330, Jour. Soil Mechanics and Found. Div., no. SM 4, p. 551–575, illus., table, 1967.

The failure of the Baldwin Hills Reservoir in Los Angeles in December, 1963, was caused by earth movement manifested by offset at a fault, permitting release of water into a highly erodible foundation. Displacement at the reservoir is attributed to general land subsidence in the vicinity. The findings of an investigation of the phenomena which precipitated the disaster are presented. Several possible causes of the movement are analyzed. Lessons to be learned from this failure are outlined.—Authors' abstract

01577 **Jarrett, P. M.** Time-dependent consolidation of a sensitive clay: Materials Research and Standards, v. 7, no. 7, p. 300–304, illus., table, 1967.

Consolidation tests have been carried out at various constant rates of loading in an effort to define the time-dependent aspects of the consolidation of Leda clay. The tests, lasting from two days to three months, provide graphic evidence of the range of time effects for this clay. It has been found that the major time effects are concentrated around the preconsolidation stress level and that subsequently they diminish to more normal proportions. The tests have been assessed with regard to the probable structural behavior of the clay. The results further emphasize the error of normal consolidation analysis around the critical zone of major time effects. The tests also appear to indicate a minimum rate of laboratory loading below which the time factor is of far less importance. One further conclusion points to a practical necessity to allow for quite large settlements at loads around the preconsolidation value.—Author's abstract

01389 **Javandel, I.; Witherspoon, P. A.** Use of thermal model to investigate the theory of transient flow to a partially penetrating well: Water Resources Research, v. 3, no. 2, p. 591–597, illus., 1967.

A thermal model constructed from a slab of steel has been used to investigate the theory of transient flow to a partially penetrating well in a confined aquifer of infinite radial extent where there is no leakage. Families of type curves have been prepared from the theoretical solution for tenth, quarter, and half penetration. Experimental results from the thermal model using the same penetrations are generally in very good agreement with the appropriate theoretical solution. This demonstrates the usefulness of the thermal model in studying transient flow problems. It is concluded that this experimental work has provided independent proof of the validity of the theoretical solution for the effects of partial penetration.—Authors' abstract

01441 **Jeffers, Jo; Trexler, Keith A.** Petrified Forest National Park: Arizona Highways, v. 43, no. 6, p. 2–31, illus., 1967.

This popular account includes descriptions of the geological background for the landscapes photographically illustrated from various points in the Petrified Forest National Park, Arizona, as well as descriptions of the petrified wood and attitude of the logs in this remnant of the Triassic forest in the Painted Desert.—GDC

Johns, W. D. *See* Huang, W. H. 01674

01555 **Johnsen, John H.; Schaffel, Simon.** The economic geology of the Mid-Hudson Valley region, *in* New York State Geol. Assoc., Guide book to field trips, 39th Ann. Mtg., New Paltz, N. Y., 1967: New York, City Coll. City Univ. New York, Dept. Geology, p. B1–B18, illus., 1967.

This is an outline of a road trip through the Mid-Hudson Valley region of New York with accompanying descriptions of the rock raw materials and mineral commodities of the Valley. In 1965, the production of the Mid-Hudson Valley accounted for one-third of the State's mineral economy. The principal products are crushed stone, building stone, lightweight aggregate, sand and gravel, cement, and brick.—LLP

Johnson, H. S., Jr. *See* Colquhoun, D. J. 01721

11056 **Jones, R. W.** Discussion—General geology and some structural features of the Courtland-Gleeson area, Cochise County, Arizona, by O. M. McRae, 1966: Soc. Mining Engineers Trans., v. 235, no. 4, p. 446–449, 1966.

Jones has previously argued that most of the complex structures in the area can be interpreted most reasonably in terms of gravity sliding, and continues to disbelieve the hypothesis of major overthrusting. Two areas where McRae (ibid., v. 235, no. 2, p. 133–138, 1966) interpreted the structure as major overthrusting are discussed. McRae attributed a collective displacement to the various thrusts of as much as four or five miles; Jones does not believe the data require shortening of anywhere near this amount. McRae argued that mineralization occurred in both Jurassic and Tertiary. The Tertiary age assignment given the mineralized rock identified as Sugarloaf quartz latite is questioned both on the basis of the age of the type section and correlation of the mineralized rock with the type section.—ESL

01698 **Jopling, Alan V.** Origin of laminae deposited by the movement of ripples along a streambed—A laboratory study: Jour. Geology, v. 75, no. 3, p. 287–305, illus., tables, 1967.

The hydrodynamic sorting processes responsible for the deposition of laminae and cross-laminae in a laboratory stream with ripple bed forms were analyzed quantitatively. The results of the analysis indicate: (a) sorting of the entrained sediment mix into relatively fine and coarse laminae is related primarily to the sorting processes operating within the heavy fluid layer flowing along the streambed, and (b) finer and coarser laminae are composed of grains derived respectively from the upper and lower parts of the heavy fluid layer. The finer laminae are formed by the settlement of suspended-load particles in the trough areas, whereas the coarser cross-laminae in the streambed are composed mainly of bed-load particles that were deposited on the ripple foresets.—*from* Author's abstract

01540 **Jordan, F. W.** Genesis of carbonate concretions in the Middle Devonian upper Ludlowville Formation, Erie County, New York [abs.], *in* New York State Geol. Assoc., Guide book to field trips, 39th Ann. Mtg., New Paltz, N. Y., 1967: New York, City Coll. City Univ. New York, Dept. Geology, p. TK2, 1967.

01862 **Joyner, Timothy; Healy, M. L.; Chakravarti, Diptiman; Koyanagi, Taku.** Preconcentration for trace analysis of sea waters: Environmental Sci. and Technology, v. 1, no. 5, p. 417–424, tables, 1967.

Phase-distribution methods which have been used for selective preconcentration in trace analysis of sea waters are briefly reviewed. Evaporation of the water produces a solid sufficiently concentrated for highly sensitive neutron activation techniques. Liquid-solid and liquid-liquid phase distribution provide greater concentration factors and selectivity suitable for less sensitive methods of analysis. A simple procedure involving coprecipitation with alkaline earth salts followed by solvent extraction of transition-metal dithiocarbamates is proposed for use on ships at sea. Recoveries of manganese, iron, nickel, cobalt, copper, zinc, and lead were shown to be in excess of 90 percent. Selective concentration of cesium and rubidium by adsorption on ammonium molybdophosphate crystals is suggested preparation for flame emission or atomic absorption analysis.—*from* Authors' abstract

Joyner, W. B. *See* U.S. Geological Survey. 01849

Kaneoka, I. *See* Ozima, M. 01487

Katz, Donald L. *See* Tek, M. Rasin. 11115

Kay, Marshall. *See* Churkin, Michael Jr. 01493

Keith, Walter. *See* Corpus Christi Geological Society. 11067

01548 **Kelley, Paul.** Stratigraphy and structure of the Rosendale area, Ulster County, New York [abs.], *in* New York State Geol. Assoc., Guide book to field trips, 39th Ann. Mtg., New Paltz, N. Y., 1967: New York, City Coll. City Univ. New York, Dept. Geology, p. TK7, 1967.

01650 **Kelley, T. E.; Buturla, Frank, Jr.** Pleistocene diversion of streams in central North Dakota, *in* Glacial geology of the Missouri Coteau—Midwest Friends of the

Pleistocene, Field Conf. 1967, Guidebook: North Dakota Geol. Survey Misc. Ser. 30, p. 117–121, illus., 1967.

Prior to glaciation, most of the rivers of North Dakota flowed northeastward toward Hudson Bay. Pleistocene glaciation partly obliterated the channels of the Yellowstone, Little Missouri, Knife, and Cannonball north and east of the present Missouri River. During Stage I of the glacial advance, the Knife and Cannonball Rivers were blocked and diverted through the Devils Lake diversion channel. A large north–south trending valley, the Spiritwood was cut into the bedrock, and probably drained southward. During Stage II, the Devils Lake diversion channel was overridden, and the Knife and Cannonball were diverted southeastward through the New Rockford Valley. During Stage III, the Knife and Cannonball were diverted to a more southerly part of the channel, through Stutsman diversion channel.—LLP

01652 **Kelling, Gilbert; Williams, Peter F.** Flume studies of the reorientation of pebbles and shells: Jour. Geology, v. 75, no. 3, p. 243–267, illus., tables, 1967.

Studies in a laboratory flume of the behavior of groups of pebbles and of two types of shell under conditions of unidirectional flow within the tranquil regime have demonstrated that different types of orientation pattern may be developed, depending largely on grain size of bed material and nature of flow. Under given conditions of flow and bed type, the mean angular response of reoriented pebbles and shells is primarily a function of flow velocity and increases reciprocally with that property. Investigation of pebble parameters suggests that, while effective weight has little influence on reorientation, Zingg shape class, sphericity and possibly roundness play some part in the pebble response. The geological significance of the experiments is discussed with particular reference to current vector analysis.—*from* Authors' abstract

01486 **Kelly, T. E.** Artificial recharge at Valley City, North Dakota, 1932 to 1965: Ground Water, v. 5, no. 2, p. 20–25, illus., table, 1967.

Valley City obtains a daily average of 750,000 gal of water from wells in partly confined gravel deposits in the Sheyenne River valley; deposits have a maximum thickness of over 50 feet and areal extent of about one sq mi. Since 1932 the aquifer has been artificially recharged by diversion of water from the river to an abandoned gravel pit, during which time the piezometric surface in the aquifer has been raised more than 22 feet with a gradual increase in quality of water. Prior to 1958 the recharge system was operated from January to June, discontinued when the piezometric surface rose to within 8 feet of the surface, following which it declined as ground water was withdrawn; annual fluctuation was 10 feet, the change in storage about 1,000 acre-feet. Since 1958 the recharge system has been operated throughout the year.—GDC

01853 **Kepferle, Roy C.** Geologic map of the Vine Grove quadrangle, Hardin and Meade Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ–645, scale 1:24,000, section, text, 1967.

Shows of oil and gas have been reported for several of 15 exploratory test holes in the Vine Grove quadrangle, but none has resulted in a commercial well. St. Louis and Salem Limestones furnish limestone for aggregate, agricultural lime, and road metal; alluvium dug from a pit along Mill Creek has been used as fill. Water for domestic and farm use is obtained from wells and springs in the basal part of the St. Louis and Salem Limestones.—MCM

01736 **Kerns, Raymond L., Jr.** Pickeringite in Oklahoma: Oklahoma Geology Notes, v. 27, no. 6, p. 112–120, illus., tables, 1967.

In an abandoned coal mine in Cimarron County, about 30 lb of a white, fibrous mineral was found as encrustations and crystalline clusters on the floor of a drift cut into the hillside. X-ray diffraction data, tabulated herein, suggested pickeringite; X-ray fluorescence provided quantitative percentages of oxides, the ideal composition compared with selected hydrated sulfates. Spectrometer scans (using LiF and gypsum analyzing crystals) and the differential thermal analysis pattern

are illustrated. The mineral is identified as a member of the halotrichite group, close to the pickeringite end member, with a small amount of manganese. A slightly higher than ideal aluminum content suggests that as much as 15 percent of the sample may be alunogenite.—GDC

01616 **Kesling, Robert V.** *Neopalaeaster enigmaticus*, new starfish from Upper Mississippian Paint Creek Formation in Illinois: Michigan Univ. Mus. Paleontology Contr., v. 21, no. 3, p. 73–85, illus., table, 1967.

Assignment of this well-preserved starfish, a new species, to *Neopalaeaster* necessitates revision of the genus. Large, shield-like plates forming sides of arms are shown to be inframarginals, not fused inframarginal and supramarginal plates as reported for *N. crawfordsvillensis* (Miller), the type species. Unusual paired plates under the distal to each primary radial seem to have no counterparts in other starfish. The new starfish reveals, for the first time, the oral surface of *Neopalaeaster*. First inframarginals are axillary, large, nearly confined to oral surface and scarcely reaching the border; second inframarginals dominate the axils; first adambulacrals are modified as oral armature; and ambulacrals are definitely opposite, equal in number to adambulacrals.—*from* Author's abstract

Kiminsky, P. D. *See* Solomonson, D. W. 01525

Kiminsky, P. D. *See* Solomonson, D. W. 01620

Kinoshita, Hazimu. *See* Ozima, M. 01487

01390 **Kirkham, Don.** Explanation of paradoxes in Dupuit–Forchheimer seepage theory: Water Resources Research, v. 3, no. 2, p. 609–622, illus., 1967.

Cutting into a porous medium of a large number of vertical, parallel, infinitely permeable, equally spaced, infinitesimally thin slots produces a fictitious soil (designated a D.F. soil) that follows exactly and without paradoxes Dupuit's assumptions and hence Dupuit–Forchheimer (D.F.) drainage theory in two dimensions. For this soil, a derived formula for the proper depth and spacing of ditches and drain tiles is the same as in conventional D.F. literature, is valid for both tiles and ditches and known to hold approximately for actual soils, and is exact for a D.F. soil. Dupuit's 2-dimensional 'parabolic seepage problem' and others now may be considered as exactly solvable for D.F. soils. For 3-dimensional axially symmetric seepage flow, the fictitious slots of a D.F. soil become concentric coaxial rings. D.F. streamlines are not horizontal; they converge in a special way.—*from* Author's abstract

11064 **Kistler, Ronald W.** Structure and metamorphism in the Mono Craters quadrangle, Sierra Nevada, California: U.S. Geol. Survey Bull. 1221-E, p. E1–E53, illus., tables, 1966.

Three sequences of metamorphic rocks in the Mono Craters quadrangle occur as roof pendants in a series of Mesozoic granitic plutons. The Paleozoic Lewis marine sediments were probably folded during a Permian orogeny tentatively correlated with the Sonoma orogeny. Koip clastics and volcanics (Permian?) were deposited unconformably on the Lewis, followed by Triassic deformation, deposition of the Jurassic Dana clastics and volcanics, and the Nevadan orogeny. Cenozoic history was characterized by uplift and erosion; the effects of Pleistocene glaciation, volcanism, and faulting are evident. Mineral assemblages of the roof pendants are compatible with the hornblende facies of contact metamorphism and almandine–amphibolite facies of the regional metamorphism.—LLP

01413 **Kisvarsanyi, Geza.** Geochemical and petrological study of the Precambrian iron metallogenic province of southeast Missouri [abs.]: Dissert. Abs., Sec. B., Sci. and Eng., v. 27, no. 9, p. 3150B–3151B, 1967.

01469 **Kitani, Osamu.** Stress–strain relationships for soil with variable lateral strain [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 9, p. 3080B, 1967.

01825 **Kittrick, J. A.** Gibbsite-kaolinite equilibria: Soil Sci. Soc. America Proc., v. 31, no. 3, p. 314–316, illus., 1967.

In order to help determine if the equilibria reached by soil mineral mixtures is that predicted on the basis of single minerals, two kaolinite samples were equilibrated individually and also with gibbsite of known stability. One set of samples was equilibrated from undersaturation, the other from supersaturation. Samples were analyzed periodically and equilibrium values obtained by extrapolation to infinite time. The solution ion compositions found were those predicted on the basis of the solubilities of the individual minerals.—Author's abstract

01428 **Klassen, R. W.; Delorme, L. D.; Mott, R. J.** Geology and paleontology of Pleistocene deposits in southwestern Manitoba: Canadian Jour. Earth Sci., v. 4, no. 3, p. 433–447, illus., tables, 1967.

Sediments containing fossils and organic material occur within Pleistocene deposits underlying multiple tills in the Duck Mountain and Riding Mountain Uplands of southwestern Manitoba. Pollen, ostracods, and mollusks within the sediments on Duck Mountain indicate a cool–warm–cool climatic sequence, which began more than 37,760 years B.P. Bones of a ground squirrel (*Citellus*) and vole (*Microtus*) were recovered from an intertill silt on Riding Mountain. Grass associated with the bones was dated as more than 31,300 radiocarbon years B.P. The sediments may be correlative with some of the beds of the recently redefined Port Talbot interstade in the Lake Erie region, though it is inferred they are older and correlative either with an early Wisconsin interstade or with the Sangamon interglacial in the mid-western United States.—Authors' abstract

01757 **Klemic, Harry.** Geologic map of the Hopkinsville quadrangle, Christian County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-651, scale 1:24,000, section, text, 1967.

Limestone is quarried for concrete, roads, agricultural purposes, and riprap from the Ste. Genevieve Limestone at two localities, and abundant reserves of similar quality exist elsewhere in the Hopkinsville quadrangle. Residual clay on the Ste. Genevieve is dug for use in brick and heavy clay products and large areas are covered by similar clay containing little or no chert. Water for domestic use is obtained from wells drilled in limestone in rural areas, but generally there is not sufficient ground water for irrigation purposes. Of two tests drilled for oil in the limestone beds below the Chattanooga Shale, one had a show but no records are available to indicate the identity of oil-bearing strata.—MCM

01839 **Kluge, Arnold G.** Higher taxonomic categories of gekkonid lizards and their evolution: Am. Mus. Nat. History Bull., v. 135, art. 1, p. 1–59, illus., tables, 1967.

The lizard family Gekkonidae consists of 82 genera and about 650 species. Important aspects of their general biology are summarized for the first time and the family is characterized on the basis of morphology. In reviewing the fossil history, it appears that the extinct Late Jurassic family Ardeosauridae is directly ancestral to gekkos; a Late Jurassic–Early Cretaceous origin for the Gekkonidae is suggested. A new subfamilial classification is proposed, based on examination of the morphology of all genera and 283 species, 1,000 specimens. The 18 diagnostic characters are discussed and the 82 genera are grouped into four subfamilies which are consistent with recognized zoogeographical concepts. The derivation, place of origin, and early evolution are traced for each subfamily.—ESL

01903 **Ko, Hon-Yim; Scott, Ronald F.** Deformation of sand in hydrostatic compression: Am. Soc. Civil Engineers Proc., v. 93, paper 5245, Jour. Soil Mechanics and Found. Div., no. SM 3, p. 137–156, illus., 1967.

The deformational behavior of a granular soil under hydrostatic compressive stress is studied. A theoretical model consisting of regular arrays of uniform spheres, but with a probabilistic distribution of holes in the arrays, is postulated. When Hertzian behavior at the points of contact between the spheres is assumed and the holes are made to close under increasing pressure, a theoretical hydrostatic stress-strain relationship is derived. The theory is used to predict the compression of

an Ottawa sand at various densities, and is found to give good agreement with the measurements obtained by testing the soil in a new apparatus. The behavior is found to be nonlinear but almost completely elastic.—Authors' abstract

Kobayashi, Kazuo. *See* Ozima, M. 01487

01456 **Koch, B. Eske.** To velbevarede fossile nödfrugter fra Agatdalens Paleocän, Nugssuaqhalvöen, Nordvestgrönland: Dansk Geol. Foren. Medd., v. 17, no. 1, p. 155–159, illus., 1967.

Two kinds of nuts or nutlike fruits of angiosperms are described from Paleocene sediments at Agatsdalen, Nugssuaq Peninsula, northwestern Greenland. The well-preserved specimens are carbonized, with supplementary calcification in the more permeable tissues. Represented by about 50 specimens is a nut resembling the Recent *Picrodendron*, the Jamaica walnut, and tentatively assigned to family Picrodendraceae, order Juglandales. The shell is carbonized; calcification preserves the internal structure of the fissured kernel. The other fruit, 15 specimens, is that of a coryphoid palm (subfamily Coryphoideae, family Arecaceae); the carbonized testa is infolded into the calcified endosperm. The palm fruit is compared with one of Danian age from Niaqornat in the Tunorssuaq Valley. Associated leaves are briefly mentioned.—VMJ

01673 **Kodama, H.; Brydon, J. E.; Stone, B. C.** X-ray spectrochemical analysis of silicates using synthetic standards with a correction for interelemental effects by a computer method: Geochim. et Cosmochim. Acta, v. 31, no. 4, p. 649–659, tables, 1967.

A computer program has been adapted for determining the coefficients required to correct for interelemental absorption and enhancement effects. Synthetic mixtures were prepared for determining the correction coefficients and standard curves. The method is shown to be as precise and accurate as any similar method with or without background correction.—DBV

11071 **Koehler, J. H.** Data on water wells in the eastern part of the Antelope Valley area, Los Angeles County, California: California Dept. Water Resources Bull. 91-12, [426] p., illus., tables, 1966.

The data presented in this report were collected by the U.S. Geological Survey as a phase of the cooperative investigation of water wells and general hydrologic conditions throughout much of the desert region of southern California. The eastern part of the Antelope Valley area, characterized by gently sloping alluvial plains and fans that extend into the area from northern slopes of the San Gabriel Mts., is bounded on the southwest by the San Andreas fault zone. Lovejoy, Alpine, and Black Buttes form the major relief. The geology, shown on map in pocket, is generalized from the published and unpublished mapping by Dibblee. Well data, compiled from U.S.G.S. Water-Supply Papers, and reports by the California Dept. Water Resources, along with some pertinent open-file information, includes drillers' logs and chemical analyses of water.—GDC

Koide, Minoru. *See* Bieri, Rudolf H. 11098

01869 **Komuro, Saburo; Simmons, Daryl B.** River-bed degradation below dams: Am. Soc. Civil Engineers Proc., v. 93, paper 5335, Jour. Hydraulics Div., no. HY 4, p. 1–14, illus., tables, 1967.

A differential equation for degradation is derived by considering variations in friction velocity, critical friction velocity, sediment size, depth of flow, and river width. The armoring effect for nonuniform bed material, which is an important factor in the analysis of degradation problems, is included in the theoretical analysis. Methods of predicting the river-bed degradation below dams are developed by using a differential equation. Numerical examples for a final equilibrium profile demonstrate applications of the method to rivers.—Authors' abstract

Kono, M. *See* Ozima, M. 01487

Koyanagi, Taku. *See* Joyner, Timothy. 01862

Kranck, E. H. *See* Clarke, T. H. 01432

11069 **Krauskopf, Konrad; Beiser, Arthur.** Fundamentals of physical science (5th edition): New York, McGraw-Hill Book Co., 701 p., illus., tables, 1966; originally published 1941.

Seven of the thirty-three chapters of this text deal with geology—earth materials, rocks, erosion and sedimentation, vulcanism and diastrophism, within the Earth, interpreting the rock record, and earth history; one discusses the atmosphere. The remaining chapters are devoted to aspects of physics, chemistry, and astronomy.—ESL

01607 **Kretz, R.** Granite and pegmatite studies at Northern Indian Lake, Manitoba [with French abs.]: Canada Geol. Survey Bull. 148, 42 p., illus., tables, 1967.

Granitic rocks underlie most of the area about Northern Indian Lake. Plastic flow in these rocks is made evident by: (1) inclusions that have been stretched, bent, disjointed, or irregularly deformed; (2) quartz-feldspar dykes that have been folded, disjointed, or deformed by shear movement; (3) the presence of compositional foliation and lineation within granitic rocks at some distance from zones of dislocation. The concept of plastic flow at relatively deep crustal levels may be applicable to problems of flow and emplacement of granitic rock in the Canadian Shield.—Author's abstract

Krouse, H. R. *See* MacPherson, D. S. 01371

01372 **Krouse, H. R.** General comment on microbiological activity and its effects on isotopic studies of water [summ.], *in* Isotope techniques in the hydrologic cycle—Symposium, Univ. Illinois, 1965: Am. Geophys. Union Geophys. Mon. Ser., no. 11, p. 195, 1967.

Krushensky, Richard D. *See* Noble, Donald C. 01854

Kulm, LaVerne D. *See* Byrne, John V. 01863

01717 **Laird, Wilson M.** A note on preglacial drainage in the Northern Great Plains, *in* Glacial geology of the Missouri Coteau—Midwest Friends of the Pleistocene, Field Conf. 1967, Guidebook: North Dakota Geol. Survey Misc. Ser. 30, p. 167-170, illus., 1967.

In order to explain the width of the Minnesota River trench and the presence of cross valleys in North Dakota, the following interpretation of geologic events is presented: Preglacial northeast-flowing streams were interrupted by advancing ice and diverted southeastward largely by way of the Minnesota River. Cross channels were filled with drift and diverted into the James River, ice-margin channels developed, and the present course of the Missouri River was established. When the ice receded north and east of the Missouri Coteau, southeasterly drainage of the meltwater may have developed.—LLP

01414 **Lajtai, Emery Zoltan.** Pleistocene sediments of the Bloor-Danforth Subway section, Toronto, Canada [abs.]: Dissert. Abs., Sec. B., Sci. and Eng., v. 27, no. 9, p. 3151B, 1967.

01640 **Lamar, D. L.; Merifield, P. M.** Influence of solar tidal torque on length of day and synodic month: Jour. Geophys. Research, v. 72, no. 14, p. 3734-3735, illus., 1967.

Previous calculations of the length of the day in Middle Devonian time, based on growth lines in corals (ibid., v. 71, p. 4429-4430, 1966) are modified to include the ratio of solar-to-lunar torque (β) and the ratio of the Earth's moment of inertia in the past to its present value ($c = C/C_o$). Calculations for c "not equal to" 1.00 show that changes in the Earth's moments of inertia of up to about $\pm 1/100$ since Middle Devonian are consistent with the data, depending on which value of β is

assumed. In view of the uncertainty in the present value of β and the impossibility of projecting poorly understood processes into the past, it is interesting that the coral growth line counts give an estimate of the average value of β from the time the organisms lived.—DBV

01455 **LaMoreaux, Philip E.** Water, minerals and oil in the south—A frontier of our nation's resources: Alabama Geol. Survey Circ. 40, 24 p., illus., 1967.

The South is one of the areas of the United States most blessed with rainfall, accompanied by favorable geologic conditions for recharge and storage of ground water, particularly the tremendous volumes of unconsolidated sediments underlying the Alantic and Gulf Coastal Plain, briefly described in this review. Also in this area are over 27 billion barrels of oil in reserve, to be transported by radial pipeline systems to midcontinent and eastern seaboard areas, and an approximately 30 billion ton reserve of coal and lignite, over half accessible to waterways. The abundance and variety of other mineral resources are noted.—GDC

01645 **Landes, Kenneth K.** Eometamorphism, and oil and gas in time and space: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 6, pt. 1, p. 828–841, illus., 1967.

Eometamorphism (early metamorphism) limits distribution of indigenous oil and gas in time and space. Unmetamorphosed Precambrian sedimentary rocks may contain indigenous petroleum, but late Pleistocene deposits probably do not. Agents of eometamorphism are addition of heat and increase in pressure, and the recorders are coal, shale, reservoir rocks, and hydrocarbons in the rocks. Petroleum is very responsive to heat and pressure. Maximum depth of the commercial oil floor is estimated at 27,500 feet, and the commercial gas floor is an "assay floor."—WLA

01444 **Lange, Arthur L.** Origin of cave ghosts: Caves and Karst, v. 9, no. 2, p. 9–12, illus., 1967.

Speleofacts, formed by removal of material, addition of material, or both, are of two general types: *speleogens*, such as scour troughs, dome pits, and drip pockets; *speleothems*, such as flowstone, stalactites, and cave pearls. The present paper examines compound forms, those arising from alternation between solution and deposition. They are in effect ghosts of their speleogens; though no vestige of crusts remains, their former presence is betrayed by the form. These are illustrated in stages of development; Leviathan Cave, Nevada, is cited for one of the best displays of ghosts.—GDC

11110 **Lange, Ian M.; Reynolds, Robert C.; Lyons, John B.** K/Rb ratios in coexisting K-feldspars and biotites from some New England granites and metasediments: Chem. Geology, v. 1, no. 4, p. 317–322, illus., tables, 1966.

Coexisting K-feldspars and biotites of 13 New Hampshire and three other New England rocks were analyzed quantitatively by X-ray fluorescence for potassium and rubidium. K/Rb fractionation between the 16 K-feldspars is constant and not temperature dependent for the range of datum points observed. Other data in the literature suggest that there is very little K/Rb fractionation between coexisting tecto- and phyllo-silicates over the entire spectrum of geologic temperatures.—Authors' abstract

Larson, E. E. *See* Ozima, M. 01487

01564 **Larson, Lawrence T.** Mineral resources summary of the Ashland City quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 6 p., 1967.

This summary accompanies Tennessee Div. Geology Geol. Map GM 304-SE, 1967, by R. E. Lounsbury (cited separately). Mineral resources mined in the Ashland City quadrangle are limestone, sand and gravel, and chert. Limestone formations exposed at the surface include the Warsaw (best source, maximum exposed thickness 140 feet), the St. Louis (maximum thickness 160 feet), Fort Payne (cherty, thickness about 300 feet), and Lego (about 10 feet exposed). Sand and gravel have been dredged from the Cumberland River bed and mined from its floodplain; deposits

of potential importance for local use are along creeks. Chert is abundant in residuum of the Fort Payne, Warsaw, and St. Louis Formations.—MCM

Larson, Lawrence T. *See* Barnes, Robert H. 01567

01571 **Larson, Lawrence T.** Mineral resources summary of the Beaverdam quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 13 p., tables, 1967.

This summary accompanies Tennessee Div. Geology Geol. Map GM 41-NE by R. H. Barnes and C. W. Wilson, Jr. (1967), which is cited separately. Iron ore has been mined since about 1836 but all mines are now abandoned. Most of the deposits are on or near crests of ridges, the ores being enclosed in clay and chert debris derived mainly from weathering of siliceous limestones of the Mississippian Fort Payne Formation with a few blocks from the Warsaw Limestone. The ore is mostly limonite with some goethite and ranges in color from yellowish-brown to red and black. All chert pits are on slopes of ridges underlain chiefly by the Fort Payne Formation; thickness as exposed in the pit faces ranges from 10 to 55 feet. Potential resources are sand, gravel, and limestone.—MCM

01589 **Larson, Lawrence T.** Mineral resources summary of the Cheatham Dam quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 4 p., 1967.

This summary accompanies Tennessee Div. Geology Geol. Map GM 304-SW by G. K. Moore and R. E. Lounsbury (1967), which is cited separately. Mineral resources mined in the Cheatham Dam quadrangle are limestone, gravel, and chert, but there is no current mineral production. Both the Warsaw and St. Louis Limestones are present, but only the Warsaw has been quarried; maximum thickness of the Warsaw is 150 feet, of the St. Louis about 160 feet. Sand and gravel have been obtained by dredging alluvial material from the Cumberland River bed. The Fort Payne Formation is the best source of chert.—MCM

Larson, Lawrence T. *See* Swingle, George D. 01762

01427 **Lasalle, Pierre; Rondot, Jehan.** New ^{14}C dates from the Lac St-Jean area, Quebec: Canadian Jour. Earth Sci., v. 4, no. 3, p. 568–571, illus., 1967.

Carbon-14 dates on marine shells from Quaternary deposits of the Lac St-Jean area are: Chicoutimi, 8,680±80 yr B.P.; Kenogami, 8,630±80 yr B.P.; St. Fulgence, 9,380±60 yr B.P.; Desbiens, 9,560±350 yr B.P.; and Metabetchouan, 10,060±350 and 10,250±350 yr B.P. The results of the dating have important implications on the deglaciation of the area: (1) The youngest shell dates indicate that the Champlain episode and the marine invasion of the area may have overlapped by a few hundred years. (2) The maximum age obtained on the marine shells may be a minimum age for the time of deposition of the St. Narcisse moraine; a reasonable age for the moraine would be between approximately 10,500 and 11,000 yr B.P.—LLP

01659 **Lee, Donald E.; Bastron, Harry.** Fractionation of rare-earth elements in allanite and monazite as related to geology of the Mt. Wheeler mine area, Nevada: Geochim. et Cosmochim. Acta, v. 31, no. 3, p. 339–356, illus., tables, 1967.

Rare-earth contents of 20 allanites and 13 monazites, accessory minerals from a restricted outcrop of intrusive granitic rocks, are reported. The sum of the atomic percentages of La, Ce, and Pr (Σ) is used as an index of composition with respect to the rare-earth elements. Values of Σ show an appreciable range for these allanites and monazites. The degree of fractionation of rare earths varies directly with CaO content of the rocks, which in turn depends on the proximity of limestone. The explanation for the concentration gradients observed in this chemical system must involve assimilation more than magmatic differentiation.—DBV

01424 **Lee, P. J.; Winder, C. G.** Fabric of a Middle Ordovician limestone at Colborne, Ontario: Canadian Jour. Earth Sci., v. 4, no. 3, p. 529–540, illus., table, 1967.

Limestones in the Middle Ordovician Cobourg Formation are: 49 percent sparse biomicrite, 26 percent fossiliferous micrite, 23 percent biosparite, 2 percent micrite, and a trace of packed biomicrite. Some beds display graded bedding at the base,

followed by a zone of lamination, and structureless micrite at the top. Factor analysis suggests that the association of brachiopod shells and pelmatozoan fragments was controlled by a common environment influence, the bryozoa and ostracod remains were transported together with reworked quartz grains, whereas the distribution of trilobite fragments was controlled by another condition. The carbonate sedimentation occurred in a marine environment of generally low turbulence. Stronger currents were introduced sporadically to form graded and non-graded biosparites.—*from* Authors' abstract

01846 **Lenau, Charles W.** Seepage under structures on stratified soil: Am. Soc. Civil Engineers Proc., v. 93, paper 5378, Jour. Eng. Mechanics Div., no. EM 4, p. 39–53, illus., 1967.

The seepage under a flat-bottomed structure resting on two homogenous strata of soil is studied by perturbation techniques. The solution obtained is valid when the permeability in the lower stratum is much greater than the permeability in the upper one. A comparison is made between Polubarinova-Kochina's exact solution for equal strata thicknesses and the perturbation solution. The final equations which contain only elementary functions are easily used with the aid of a slide rule. Results are also presented in graphs.—Author's abstract

01676 **Lennox, D. H.; Carlson, V.** Geophysical exploration for buried valleys in an area north of Two Hills, Alberta: Geophysics, v. 32, no. 2, p. 331–362, illus., tables, 1967.

Comparison of the application of resistivity, seismic refraction, and gravity methods to ground water prospecting in the Two Hills area revealed a considerable variation in their suitability. Resistivity exploration could trace buried valleys containing appreciable thicknesses of sands and gravels overlying bedrock, but were not successful for determining bedrock depth due to lack of contrast. The refraction method was reasonably successful in determining both buried valley trends and bedrock depths. Gravity exploration was least successful, as the observed anomalies apparently originated at some depth in the bedrock.—DBV

Leonard, J. W. *See* Donahue, B. A. 01806

01551 **Lewis, John R.** Structure of the northern half of the Rossie Complex, northwest Adirondacks, New York [abs.], *in* New York State Geol. Assoc., Guide book to field trips, 39th Ann. Mtg., New Paltz, N. Y., 1967: New York, City Coll. City Univ. New York, Dept. Geology, p. TK9, 1967.

11100 **Lillegraven, Jason A.** *Bison crassicornis* and the ground sloth *Megalonyx jeffersoni* in the Kansas Pleistocene: Kansas Acad. Sci. Trans., v. 69, nos. 3–4, p. 294–300, tables, 1966.

An almost complete skull of a ground sloth discovered in or along the south bank of the Kansas River in Johnson County is referable to *Megalonyx jeffersoni*. A series of skulls of Recent tree sloths was studied and remarkable variability was observed in characters used by Lindahl for the separation of *Megalonyx leidyi* from *M. jeffersoni*. On comparison of *M. leidyi* with the new skull, it is suggested that *Megalonyx leidyi* be relegated to the synonymy of the older name, *Megalonyx jeffersoni*. A large bison cranium found at Morris, Wyandotte County, is identified as *Bison (Superbison) crassicornis*, and provides a considerable extension southward of the known late Pleistocene range.—ESL

01665 **Lipschutz, Michael E.** X-ray diffraction analysis of cohenite from iron meteorites: Geochim. et Cosmochim. Acta, v. 31, no. 4, p. 621–633, illus., tables, 1967.

X-ray diffraction investigation of cohenite from 50 Canyon Diablo meteorites and 8 Odessa shock standards showed alterations which apparently represent successive stages in solid state recrystallization of cohenite. A pressure scale is established, based on features observed in diffraction photographs of cohenite grains from shock standards, which is qualitatively consistent with metallographic shock criteria. Estimates from metallographic criteria of the degree of shock suffered by Canyon

Diablo meteorites are essentially paralleled by estimates based on cohenite alteration. X-ray technique also can identify shocked meteorites which have not been at a pressure high enough to induce metallographic changes.—DBV

01733 **Lister, C. R. B.** Shallow seismic profiling in Saanich Inlet: Northwest Sci., v. 41, no. 2, p. 80–83, illus., 1967.

In an attempt to obtain information on the sediment structure and thickness in the fjordlike marine basin on the east side of Vancouver Island, British Columbia, a pilot-type survey was made with a sparker-type seismic profiler, concentrated in the central basin where most of the varved sediment lies. Significant echoes have been reduced onto diagrams. The apparent subbottom depth is about 50 m. Considering the rate of deposition estimated from cored varves, if constant during the postglacial period, the glacier that formed Saanich Inlet should have retreated some 14,000 years ago. It is likely that the central basin of Saanich Inlet contains a continuous sequence of these varved sediments.—GDC

11077 **Liu, Po-Ling; Sherman, G. D.; Swindale, L. D.** Laboratory formation and characterization of taranakite in a Hydrol Humic Latosol soil from Hawaii: Pacific Sci., v. 20, no. 4, p. 496–506, illus., tables, 1966.

Crystalline taranakite formed when the Akaka soil was treated with potassium phosphate solutions ranging from 0.2 to 0.6 molar, and pH values of the reacting system ranged from 2.3 to 2.9. Characteristics were compared with those of pure synthetic taranakite using X-ray, chemical, optical, infrared absorption, and differential thermal techniques. The taranakite was essentially a potassium-aluminum-phosphate complex. There was no indication of isomorphous substitution of iron for aluminum. The molar ratios of K/PO_4 and Al/PO_4 of the reaction product were found to be 0.37 and 0.72 respectively. It is proposed that potassium and phosphate ions from fertilizer may react with aluminum ions in soil solutions to produce cryptocrystalline precipitates which, with time, will grow and transform into crystalline taranakite.—*from* Authors' abstract

01579 **Livingstone, D. A.** The use of filament tape in raising long cores from soft sediment: Limnology and Oceanography, v. 12, no. 2, p. 346–348, illus., 1967.

The advantages of using filament tape to line the inside of a sediment coring tube are described. As the tube of a piston sampler penetrates the mud, Mylar tape slides down the outside and up the inside, lining it smoothly. Although friction between the liner and sediment are eliminated, there are frictional forces in other parts of the system. Filament tape, which is strong and stretches very little, can be used to reinforce the Mylar tape and increase its breaking strength.—LLP

01601 **Lloyd, R. Michael.** Oxygen-18 composition of oceanic sulfate: Science, v. 156, no. 3779, p. 1228–1231, illus., table, 1967.

Comparison of experimental data with analyses of oceanic sulfate indicates that oceanic sulfate is not in oxygen isotope equilibrium with ocean water. Preliminary experiments suggest that the turnover of sulfate in the sulfur cycle is too rapid to allow equilibrium to be established. If this is so, the sulfur cycle must exert a significant influence on the oxygen balance of the ocean-atmosphere system.—Author's abstract

01634 **Lochman-Balk, Christina; Wilson, James Lee.** Stratigraphy of Upper Cambrian-Lower Ordovician subsurface sequence in Williston Basin: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 6, pt. 1, p. 883–917, illus., tables, 1967.

Trilobites and brachiopods of Late Cambrian and Early Ordovician age were obtained from seven wells that penetrated the Deadwood Formation in Montana and North Dakota. There is no evidence for a depositional break between Upper Cambrian and Lower Ordovician. The section contains a basal transgressive sandstone overlain by interbedded limestone-pebble conglomerate, dark shale, and light-colored sandstone. Lithofacies exhibit many lateral changes. No persistent units can be recognized for the entire basin, but local facies members useful for mapping smaller areas are distinguished. Reconstruction of paleogeographic

conditions indicate that in Late Cambrian the region was a wide shallowly inundated coastal shelf with a west–northwesterly slope that was subjected to recurring transgression of the sea.—WCC

01861 **Long, Erwin; George, Warren.** Buttress design earthquake-induced slides: Am. Soc. Civil Engineers Proc., v. 93, paper 5332, Jour. Soil Mechanics and Found. Div., no. SM 4, p. 595–609, illus., table, 1967.

The Fourth Avenue slide resulting from the 1964 Alaska Earthquake was a retrogressive translatory slide, creating a graben and horst configuration with negligible flattening of the slope or passive stabilization of the slide toe. The 900-ft-wide by 1800-ft-long slide area endangered the heart of the Anchorage business area. Stabilization was accomplished by the construction of a gravel buttress designed to resist forces caused by sand or clay liquefaction, horizontal or circular sliding, or slumping, static or dynamic forces. New methods of slide analysis had to be devised for use in conjunction with accepted methods of normal slide analysis. Recommendations on building restrictions are provided.—Authors' abstract

01882 **Long, Erwin; George, Warren.** Turnagain slide stabilization, Anchorage, Alaska: Am. Soc. Civil Engineers Proc., v. 93, paper 5333, Jour. Soil Mechanics and Found. Div., no. SM 4, p. 611–627, illus., table, 1967.

The Turnagain Slide was a large area of retrogressive translatory sliding, resulting from the earthquake-induced liquefaction of soft sensitive Bootlegger clay including sand lenses. A slope-stability chart, derived from analysis of bluffs in the Anchorage area, indicated marginal earthquake stability of the area after sliding. Extremely low clay strengths under the toe of the slide along the seaward sloping surface indicated loss of this toe and the stabilization it provided in another earthquake. Stabilization model studies on blast remolding with sand drainage and later with electro-osmosis treatment were conducted. Tests conducted in early 1966 showed that soil strength under the seaward toe of the slide would not fail in an equivalent future earthquake. Recommendations were made to protect the slide toe against future erosion believed to be caused primarily by ice rafting of soil.—*from* Authors' abstract

Lounsbury, Richard E. *See* Moore, Gerald K. 01497

01498 **Lounsbury, Richard E.** Geologic map of the Ashland City quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 304-SE, scale 1:24,000, separate text, 1967.

The text accompanying this map, "Mineral resources summary of the Ashland City quadrangle, Tennessee," by L. T. Larson (1967) is cited separately.—MCM

Lovering, John F. *See* Ehmann, William. 01661

Lowe, Barbara V. *See* Merriam, Richard H. 01876

01781 **Lowry, Marlin E.; Crist, Marvin A.; Tilstra, John R.** Geology and ground-water resources of Laramie County, Wyoming: U.S. Geol. Survey Water-Supply Paper 1834, 71 p., illus., tables, geol. map, 1967.

The most extensive aquifers in Laramie County are the Oligocene White River Formation, as much as 50 feet thick and predominantly siltstone; Miocene Arikaree Formation, as much as 450 feet of fine-grained sandstone; and the Miocene and Pliocene Ogallala Formation, as much as 330 feet of gravel, sand, silt, and some cobbles and boulders. Quaternary terrace deposits yield moderate to large supplies of water in the southeastern and northeastern parts of the county. Precipitation is the principal source of recharge to the ground-water reservoirs. Total amount of ground water pumped from wells during 1964 is estimated to be 28,000 acre-feet. Chemical quality from principal aquifers and streams is generally suitable for domestic, irrigation, and industrial uses.—*from* Authors' abstract

Loy, Teresita. *See* Ponnamperuma, F. N. 01743

Luterbacher, Hanspeter. *See* Grönhagen, Doris. 11109

Lyle, Robert E. *See* Hansen, Wallace R. 11108

Lyons, John B. *See* Lange, Ian M. 11110

01430 **MacIntyre, I. G.** Submerged coral reefs, west coast of Barbados, West Indies: Canadian Jour. Earth Sci., v. 4, no. 3, p. 461–474, illus., table, 1967.

Seven sonar profiles of the sea floor were made at 3-mile intervals approximately perpendicular to the west coast of Barbados, W. I. Evidence from the profiles, first-hand observations, and deep-sea photographs indicate that two submerged barrier reefs parallel the coast at approximate depths of 70 and 230 feet. A trench is present in a deeper part of the sloping sea floor. Positions of the submerged barrier reefs probably were controlled by pauses in the post-Pleistocene eustatic rise in sea level. The First Ridge was established on an erosional terrace that could have been cut during a stillstand between 12,500 and 11,500 years B.P., and Second Ridge during a stillstand between 16,500 and 15,000 years B.P. The trench appears to have resulted from faulting or submarine outcropping of Tertiary sedimentary rocks.—*from* Author's abstract

01371 **MacPherson, D. S.; Krouse, H. R.** O^{18}/O^{16} ratios in snow and ice of the Hubbard and Kaskawulsh glaciers, *in* Isotope techniques in the hydrologic cycle—Symposium, Univ. Illinois, 1965: Am. Geophys. Union Geophys. Mon. Ser., no. 11, p. 180–194, illus., tables, 1967.

Samples collected from Hubbard and Kaskawulsh glaciers in the St. Elias Mountains were analyzed for O-18/O-16 content; δO-18 values ranged from -18 to -29. Pits studied before extensive melting showed definite trends in δO-18 with more negative values corresponding to winter precipitation. The average of all pits studied above the firn line gave no indication of an altitude variation larger than the sampling error; average trend below the firn line was a decrease in δO-18 from firn line to terminus. A transverse profile below the firn line gave consistent values near stream margins whereas stream centers had decidedly more positive or negative values. Precipitation studies exhibited much scatter and did not show the expected altitude variation. Comparison of data with that of others suggests that much of the precipitation in the area is derived from the Pacific Ocean.—*from* Authors' abstract

Madsen, B. M. *See* Murata, K. J. 01476

Major, C. F. *See* Richter, D. H. 01529

11072 **Malahoff, Alexander; Woollard, G. P.** Magnetic surveys over the Hawaiian Islands and their geologic implications: Pacific Sci., v. 20, no. 3, p. 265–311, illus., tables, 1966.

The area on and adjacent to the Hawaiian Ridge is characterized by elongated anomalies extending for several tens of kilometers and by anomalies centered over local areas and superimposed on the axes of the former. Local anomalies are associated with centers of volcanism but most of the elongate have no surface geologic expression and are believed to represent intrusion of mantle material into rifts. The majority of anomalies defining crustal rifts strike parallel to the Molokai fracture zone or to the crest of the Ridge, the latter truncating the former. Data available only at the eastern end support the concept of progressive development of the Islands along a major fault, but the Molokai zone has played an important part in the development of islands east of Molokai and volcanoes have formed where the two tectonic elements intersect. Polarization is conformable with the present field.—ESL

Malloy, Richard J. *See* vonHuene, Roland. 01562

Mamet, B. *See* Toomey, Donald Francis. 01449

01776 **Mandel, Samuel.** Underground water: Internat. Sci. and Technology, no. 66, p. 35–41, illus., 1967.

The principal problem in water management is one of determining how much water can be pumped safely. To determine this the hydrologist relies on field tests, meteorological data, geophysical measurements, mathematical models, and other techniques. He may also turn to methods of artificial recharge, and he must take care to prevent accretions of impurities, and guard against intrusion of sea water. The ultimate problem, however, is securing cooperation between those who tap the water and those who are attempting to manage it.—ESL

01521 **Marcher, Melvin V.** Geologic map of the Tharpe quadrangle, Tennessee (including the Tennessee portions of the Model, Rushing Creek, and Hamlin quadrangles, Kentucky–Tennessee): Tennessee Div. Geology Geol. Map GM 28–SW, scale 1:24,000, separate text, 1967.

The accompanying text, "Mineral resources summary of the Tharpe quadrangle, Tennessee," by R. H. Barnes, L. T. Larson, and R. E. Hershey (1967) is cited separately.—MCM

Marcus, Leslie F. *See* Fagerstrom, J. A. 01791

01379 **Marine, I. Wendell.** The use of a tracer test to verify an estimate of the groundwater velocity in fractured crystalline rock at the Savannah River plant near Aiken, S.C., *in* Isotope techniques in the hydrologic cycle—Symposium, Univ. Illinois, 1965: Am. Geophys. Union Geophys. Mon. Ser., no. 11, p. 171–179, illus., table, 1967.

A recent investigation at the Savannah River plant indicated the technical feasibility of and the safety afforded by storage of high-level radioactive wastes in unlined chambers excavated in crystalline rock about 1,500 feet beneath the ground surface. To test the validity of hydraulic estimates, a between-holes tracer test using tritium was designed. Water is pumped from one rock well and piped to another 1,760 feet away. In August, 1964, 300 curies of tritium were injected; the tritium was first detected 73 days later and since then the concentration has increased steadily. It appears that the peak concentration of tritium was reached in about a year, making the average ground-water velocity 1,760 feet/yr. The predicted average velocity for the tracer test was 320 feet/yr, making this estimate too low by a factor of 5.5.—*from* Author's abstract

Marr, John D. *See* Rosenkrans, R. R. 01594

01582 **Marshall, R. P., Jr.** Gyp Hill Dome, Brooks County, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 64–68, illus., tables, 1967.

Marvin, R. F. *See* Robinson, G. D. 01490

01739 **McAndrews, John H.; Stewart, Robert E., Jr.; Bright, Robert C.** Paleoecology of a prairie pothole—A preliminary report, *in* Glacial geology of the Missouri Coteau—Midwest Friends of the Pleistocene, Field Conf. 1967, Guidebook: North Dakota Geol. Survey Misc. Ser. 30, p. 101–113, illus., tables, 1967.

This is a preliminary report because C-14 dates and chemical analyses are lacking. The biota and environment of late-Wisconsin and postglacial time are recorded from sediments of glacier-formed lakes and potholes of the Missouri Coteau. Climatic conditions probably have less significance in the succession of upland vegetation than do soil development and availability of plant species. However, sediment studies concerning water depth and water quality may provide a reliable means of reconstructing late-glacial and postglacial climatic history.—LLP

01794 **McCulloh, Thane H.** Mass properties of sedimentary rocks and gravimetric effects of petroleum and natural-gas reservoirs: U.S. Geol. Survey Prof. Paper 528-A, p. A1–A50, illus., tables, 1967.

Analyses of possible causes of small local gravity minimums associated with some oil fields in California and USSR, have led to examination of mass properties of sedimentary rocks and gravimetric effects of petroleum and natural-gas reservoirs.

Petroleum and natural gas under reservoir conditions are sufficiently less dense than interstitial water and brine that most commercial hydrocarbon reservoirs should produce negative gravimetric effects. Such effects are small enough to be obscured in surface gravity anomalies produced by larger subsurface mass irregularities. Reservoirs of large volume, large volume–area ratio, high porosity, shallow depth, high gas–oil ratio, and low water content are most likely to produce distinctive recognizable minimums. Furthermore, a borehole gravimeter of high precision would permit gravity measurements to be made three-dimensionally to partially overcome effects of depth attenuation of even small anomalies.—THM

McDonald, C. C. *See* Olmsted, F. H. 01586

01573 **McGuinness, Charles L.** Urbanization—Can we live with it?: Water Resources Bull., v. 3, no. 1, p. 17–20, 1967.

Aside from the catastrophic events which can cause difficulties in urban areas, there are less precipitous but just as costly effects on water supply, such as: land subsidence resulting from withdrawal of artesian water or of oil and gas, storm drainage changes, erosion and sedimentation resulting from building activities or from devegetation following air pollution, and contamination of local water sources by domestic and industrial wastes. The biggest problem is a mental one brought on by rising costs of combatting nature. Geologists and hydrologists can contribute valuable information to assist in preventive and corrective planning.—GDC

01843 **McIntyre, Andrew; Bé, Allan W. H.** *Coccolithus neohelis* sp. n., a coccolith fossil type in contemporary seas: Deep-Sea Research, v. 14, no. 3, p. 369–371, illus., 1967.

A new coccolithophorid species found in surface waters off Bermuda possesses a cruciform structure strongly reminiscent of forms from Eocene and older sediments. This living species presents a problem to the micropaleontologist in that it can be mistaken for contamination of Recent sediments by lower Tertiary and Cretaceous material.—Authors' abstract

McKay, Edward J. *See* Noble, Donald C. 01854

01373 **McKee, E. H.; Nash, D. B.** Potassium–argon ages of granitic rocks in the Inyo batholith, east-central California: Geol. Soc. America Bull., v. 78, no. 5, p. 669–680, illus., table, 1967.

A total of 32 ages have been determined on minerals from 26 samples of 6 plutons, 8 dikes and sills, and 3 metamorphic rocks of the Inyo batholith. The emplacement age is 184–151 m.y. Two isolated plutons west of the batholith have ages of 138–130 m.y. and 80–77 m.y. The age ranges are similar to those of the Sierra Nevada and support the concept that the two batholiths are comagmatic.—AG

01403 **McLamore, Roy Travis.** Strength-deformation characteristics of anisotropic sedimentary rocks [abs.]: Dissert. Abs., Sec. B., Sci. and Eng., v. 27, no. 9, p. 3129B–3130B, 1967.

01875 **McLean, James D., Jr.** Oceanography needs geologists and paleontologists: Undersea Technology, v. 8, no. 6, p. 29–30, 34, 37, 1967.

The petroleum geologist, stratigrapher, and paleontologist, schooled by experience and temperament to conduct explorations and to originate projects, can better serve the field of oceanography than other scientists. The paleontologist is conversant with techniques and methods of study of marine life and with reconstruction of environments and life histories of these organisms. The special realm of the geologist is physical environments, which have been scientifically classified by such studies. Understanding of ocean environments must include the structures of the basins, ridges and other features of the sea bottom. Geophysical methods of correlation are rapid, but leave many unanswered questions for more efficient exploration.—GDC

01700 **McMaster, Robert L.; Garrison, Louis E.** A submerged Holocene shoreline near Block Island, Rhode Island: Jour. Geology, v. 75, no. 3, p. 335–340, illus., 1967.

A drowned barrier spit–lagoon–headland complex has been located south of Block Island, Rhode Island, at a depth of about 80 feet. The morphology of these submerged shoreline features is similar to that of features occurring on the Rhode Island coast at present. If isostatic adjustments have been insignificant in this area, the drowned features were related to a sea level still stand at an estimated 80 feet (24 m) below present sea level. A changing pattern of sediment types and structures across this shoreline was observed from a submarine.—Authors' astract

11051 **McRae, Otis M.** General geology and some structural features of the Courtland–Gleeson area, Cochise County, Arizona—Author's reply [to discussion by R. W. Jones, 1966]: Soc. Mining Engineers Trans., v. 235, no. 4, p. 449–450, 1966.

McRae agrees that the mechanism of gravity sliding has been more significant in the Courtland–Gleeson area, Ariz., than most workers have recognized, but is reluctant to apply this concept to all the low-angle faults. The points questioned by Jones (ibid., p. 446–449) are reviewed. A drill hole in Sec. 29, and the Pemberthy shaft demonstrate that the Dragoon plate has overridden the other plates. This could not have occurred by gravity sliding (original paper, ibid., v. 235, no. 2, p. 133–138, 1966).—ESL

McReynolds, Joseph L., Jr. *See* Swingle, George D. 01774

01512 **Medearis, Kenneth.** Reply [to comments by R. P. Gallagher on "Coupled bending and torsional oscillations of a modern skyscraper" (1966)]: Seismol. Soc. America Bull., v. 57, no. 2, p. 299, 1967.

Gallagher's suggestions (ibid., p. 297–299) regarding possible improvements in the analysis presented in the paper in question (ibid., v. 56, no. 4, p. 937–946, 1966) offer nothing new; inclusion of soil effects in structural dynamics analyses has been considered by several authors. It has been verified experimentally that base rotation and translation have little effect on a specific large multistory structure. Also, errors arising in conjunction with soil values and foundation mass might easily cancel the refinement of including them. Gallagher's model involves at least two additional degrees of freedom, pure translation and pure rotation, and does not include the foundation mass.—DBV

11104 **Meland, Nils; Norrman, John O.** Transport velocities of single particles in bed-load motion: Geog. Annaler, v. 48A, no. 4, p. 165–182, illus., 1966.

In order to determine the influence of shear velocity, bed roughness, and moving particle diameter on particle bed-load transport, velocities of single spherical glass beads moving over beds of rhombohedrally packed spherical glass beads were determined under controlled laboratory conditions. A relationship between the position of zero water velocity and bed roughness is established. Three stages of particle motion are recognized; the degree of development of each is a function of all three major variables. A more detailed consideration of the forces which tend to propel and retard a moving particle leads to the development of a semi-empirical expression for the velocity of a single particle in contact-load motion. A list of symbols is given.—*from* Authors' abstract

Melnik, V. I. *See* Zernetsky, V. F. 01831

01703 **Menard, H. W.** Transitional types of crust under small ocean basins: Jour. Geophys. Research, v. 72, no. 12, p. 3061–3073, illus., 1967.

Small ocean basins are underlain by crustal sections generally unlike those of typical continents or oceans. They can be considered to be in different stages of development. In some a normal oceanic layer is covered by exceptionally thick sediment, and it appears that a logical sequence of development is from thin to thick sediment. Elsewhere, the stage of development of different basins is obscure. A possible sequence would show continental crust gradually engulfed, replaced by oceanic crust, and covered by sediment until it again reached sea level. Many

sequences can be constructed from existing crustal sections. Crustal types intermediate between continents and oceans are not uncommon in small ocean basins. Similar basins may have been significant loci of sediment accumulation and continental accretion in the past.—DBV

Merifield, P. M. *See* Lamar, D. L. 01640

01876 **Merriam, Richard H.; Lowe, Barbara V.** Opal, the royal gem: Los Angeles County Mus. Nat. History Quart., v. 5, no. 4, p. 4–5, 30, illus., 1967.

The Newman collection of Australian black opals, shown at the Los Angeles County Museum of Natural History, is illustrated and described very briefly. The brilliant colors of precious opal, noted as a subject of scientific debate for over a century, are not due to simple light absorption, as in transparent crystalline gems, but to reflected light. The geometric arrangement of the aggregate of submicroscopic spheres in opals is a more recent suggestion.—GDC

01378 **Merritt, W. F.** Techniques of groundwater tracing using radionuclides [summ.], *in* Isotope techniques in the hydrologic cycle—Symposium, Univ. Illinois, 1965: Am. Geophys. Union Geophys. Mon. Ser., no. 11, p. 169–170, 1967.

01431 **Middleton, Gerard V.** Experiments on density and turbidity currents—[Pt.] 3, Deposition of sediment [with French abs.]: Canadian Jour. Earth Sci., v. 4, no. 3, p. 475–505, illus., tables, 1967.

Turbidity currents were formed by releasing suspensions of plastic beads from a lock into a horizontal water-filled flume. Graded beds were formed; the mechanism of deposition was studied by motion photography and the size grading by 150 size analyses. The mechanism of deposition and type of grading differed for beds deposited from suspensions with concentrations less than and greater than 30 percent by volume. Low concentration suspensions formed 'distribution grading' showing vertical and some lateral grading. High concentration suspensions formed 'coarse-tail grading' showing almost no lateral grading and little vertical. In both types of graded beds the sorting coefficient decreased upward within the bed, and to a lesser extent also laterally away from the gate. The skewness reached a maximum near the center of the bed and became negative at the top.—*from* Author's abstract

01763 **Milici, Robert C.; Finlayson, C. Pratt.** Geologic map of the Pikeville quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 110-SW [sheet 1], scale 1:24,000, section, separate text, 1967.

The accompanying text, "Mineral resources summary of the Pikeville quadrangle, Tennessee," and coal map both by Milici are cited separately.—MCM

01764 **Milici, Robert C.** Coal map of the Sewanee, Lower Wilder, and Bon Air seams, Pikeville quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 110-SW [sheet 2], scale 1:24,000, separate text, 1967.

The accompanying text, "Mineral resources summary of the Pikeville quadrangle, Tennessee," (Milici), and geologic map (Milici and Finlayson) are cited separately.—MCM

01765 **Milici, Robert C.** Mineral resources summary of the Pikeville quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 16 p., tables, 1967.

This text accompanies Tennessee Div. Geology Geol. Map GM 110-SW (geologic map, Milici and Finlayson; coal map, Milici, cited separately). Coal-bearing strata, the Pennsylvanian lower Pottsville Series, underlie the uplands of Walden Ridge and the Cumberland Plateau; coals are in shales and siltstone of the Gizzard and Crab Orchard Mountains Groups. Estimated recoverable reserves from the Bon Air, Sewanee, and Lower Wilder seams are 845,297 tons. Nineteen formations containing limestone are exposed but the five small quarries are abandoned. Chert has been mined in the Fort Payne Formation. Potential resources are sand and shale for aggregate and ceramic materials.—MCM

Milici, Robert C. *See* Coker, Alfred E. 01766

Milici, Robert C. *See* Coker, Alfred E. 01768

01769 **Milici, Robert C.; Coker, Alfred E.** Geologic map of the Melvine quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 110-NE [sheet 1], scale 1:24,000, section, separate text, 1967.

The accompanying text, "Mineral resources summary of the Melvine quadrangle, Tennessee," by Coker and Milici, and coal map by Coker are cited separately.—MCM

Milici, Robert C. *See* Coker, Alfred E. 01771

Milici, Robert C. *See* Garman, R. Keith. 01772

Miller, G. R. *See* Sokolowski, T. J. 01514

Milliman, J. D. *See* Multer, H. G. 01836

Mitronovas, Walter. *See* Sutton, George H. 01513

01399 **Money, P. L.** Discussion—"Metamorphism of the Meguma Group of Nova Scotia," by F. C. Taylor and E. A. Schiller [1966]: Canadian Jour. Earth Sci., v. 4, no. 3, p. 577–578, 1967.

The point of the discussion is that Taylor and Schiller [ibid., v. 3, no. 7, p. 959–974, 1966] should not have referred to Turner and Verhoogen's (1960) classification because the amphibolite-grade, regionally metamorphosed assemblages of Taylor and Schiller cannot be fitted into the classification, and because the pressure temperature estimates of Turner and Verhoogen (1960) are in some cases inaccurate.—LLP

01415 **Monger, James William Heron.** The stratigraphy and structure of the type-area of the Chilliwack Group, southwestern British Columbia [abs.]: Dissert. Abs., Sec. B., Sci. and Eng., v. 27, no. 9, p. 3151B, 1967.

01797 **Monkmeyer, Peter L.; Murray, Willard A.** Analyses of parameters of an unconfined aquifer—Discussion [of paper 4901 by G. J. Kriz, V. H. Scott, and R. M. Burgy, 1966]: Am. Soc. Civil Engineers Proc., v. 93, paper 5304, Jour. Hydraulics Div., no. HY 4, p. 308–310, illus., 1967.

In addition to the applications mentioned by the authors of paper 4901 (ibid., v. 92, no. HY 5, p. 49–56, 1966), the unconfined aquifer solution has been found to be applicable when the parameter C is small, that is, when the pumping rate is relatively small, or the permeability relatively large. The validity of the Dupuit-Forchheimer assumptions is questioned.—LLP

01478 **Moore, Donald B.** Subsurface geology of the Gilbertown Oil Field: Alabama Geol. Survey Circ. 35, 16 p., illus., 1967.

The Gilbertown oil field is located along an east-west trending graben-fault system crossing Choctaw County; the producing area extends about 13 miles. Three major faults control oil production which has totaled about 8,922,000 bbl. from sediments of Late Cretaceous age in the upper Eutaw Formation and from fractures in chalk beds of the Selma Group. Fractures are more numerous and larger near the top of the chalk on the downthrown side of faults into which oil from the opposite Eutaw Formation migrated. The fractured chalk offers great potential for future production, particularly in the eastern part of the Gilbertown field.—GDC

01497 **Moore, Gerald K.; Lounsbury, Richard E.** Geologic map of the Cheatham Dam quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 304-SW, scale 1:24,000, separate text, 1967.

The text accompanying this map, "Mineral resources summary of the Cheatham Dam quadrangle, Tennessee," by L. T. Larson (1967) is cited separately.—MCM

Moore, L. G. *See* Feth, J. H. 11066

01533 **Moore, Raymond C.** Unique stalked crinoids from Upper Cretaceous of Mississippi: Kansas Univ. Paleont. Contr.—Paper 17, 35 p., illus., tables, 1967.

Dunnicrinus mississippiensis, n.gen., n.sp., based on numerous specimens which include nearly complete crowns with abundant parts of columns, is described from the Prairie Bluff Chalk (Maastrichtian) of northeastern Mississippi. Specimens are representatives of the widely distributed Bourgueticrinidae, and are unique for this family in having long pinnulate arms attached to the dorsal cups. Also, proximal-intermediate and distal regions of the column are markedly dissimilar, the former evenly cylindrical with columnals of subequal diameter and height, the latter distinguished by striking zigzag longitudinal profiles. At bottom of the stalk are robust rootlike branches. Morphological descriptions are followed by discussions of ontogeny and paleoecology.—VMJ

Moore, Samuel L. *See* Woodley, Richard A. 01783

01852 **Moore, Samuel L.; Haynes, Donald D.** Geologic map of the Park quadrangle, south-central Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-634, scale 1:24,000, section, text, 1967.

Dawson and Wootens Knobs in the Park quadrangle are underlain by Ste. Genevieve Limestone and limestone of the Girkin Formation which are probably suitable for road metal, dimension stone, and agricultural lime. Oil has been produced since 1930 from the LeGrande pool from two zones of porous dolomitic limestone, below the Late Devonian Chattanooga Shale, on the western limb of the Cincinnati arch within a series of structural ridges and troughs all plunging gently northward. From 1930–35 the pool produced approximately 3,500,000 bbl oil from hundreds of wells; most wells were abandoned by 1965. Commercial quantities of oil have been encountered in holes from 0–55 feet below the Chattanooga Shale and one pool produced oil from dolomitic limestone 70–100 feet below that shale.—MCM

Moore, Willard S. *See* Sackett, William M. 11052

Moritz, Helmut. *See* Heiskanen, Weikko A. 01833

01375 **Morris, Donald A.** Use of chemical and radioactive tracers at the National Reactor Testing Station, Idaho, *in* Isotope techniques in the hydrologic cycle—Symposium, Univ. Illinois, 1965: Am. Geophys. Union Geophys. Mon. Ser., no. 11, p. 130–142, illus., tables, 1967.

Chemical and radioactive tracers were used in studies of geology and hydrology of basalt terrane at the National Reactor Testing Station. A salt tracer used near waste disposal from a processing plant indicated rates of flow ranging from 15-50 feet/day in the regional groundwater reservoir, and a sodium fluorescein dye an average rate of about 23 feet/day. Recent studies using tritium indicated average rates of flow of about 54 feet/day based on 'first arrival' and from 10–13 feet/day based on arrival of the 'center of mass' or maximum tritium concentration. Studies of water perched in alluvium and basalt underlying the area indicated a rate of flow of about 2–10 feet/day. Long-range tritium studies in the regional groundwater reservoir in the Central Facilities Area indicated rates of flow of 6–8 feet/day under normal hydraulic gradients of 5 feet/mile at distances of 4–5 miles from points of injection.—*from* Author's abstract

01416 **Morrow, Aubrey Lyndon.** The stratigraphy and invertebrate paleontology of the Colorado Group in Kansas [abs.]: Dissert. Abs., Sec. B., Sci. and Eng., v. 27, no. 9, p. 3152B, 1967.

Mott, R. J. *See* Klassen, R. W. 01428

Mountjoy, Eric W. *See* Frebold, Hans. 01779

Mower, R. W. *See* Cordova, R. M. 01778

Muir-Wood, Helen M. *See* Cooper, G. Arthur. 01789

01523 **Mulle, G. E.** San Salvador Field, Hidalgo County, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 172–175, illus., tables, 1967.

01609 **Mulle, G. E.** Murdock Pass Field, Kenedy County, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 129–131, illus., tables, 1967.

01537 **Muller, J. E.** Kluane Lake map-area, Yukon Territory (115G, 115F, E 1/2) [with French abs.]: Canada Geol. Survey Mem. 340, 137 p., illus., tables, geol. maps, 1967.

Kluane Lake map-area in southwest Yukon Territory includes part of the St. Elias Mountains and the Yukon Plateau separated by the Shakwak Trench. The rocks underlying the Yukon Plateau consist mainly of Yukon Complex metamorphics and granodiorite of the Ruby Range batholith. The schists of probable Precambrian and early Paleozoic age were metamorphosed and granitized in the Mesozoic and perhaps early Tertiary. Folding probably preceded Permian sedimentation, and the Mesozoic geosyncline ended in the Cretaceous with orogeny and granitic intrusion. Paleocene or Eocene beds are followed by thick layers of basalts with felsitic plugs. Three glaciations occurred, each showing decreasing extent; the oldest may have been pre-Wisconsin. Minor mineral deposits include placer-gold, nickel-copper sulfides, native copper, tungsten, molybdenum, gypsum, and coal.—LLP

11096 **Muller, J. E.; Christie, R. L.** Geology, Kluane Lake, Yukon Territory: Canada Geol. Survey Map 1177A (also in Mem. 340), scale 1:253,440, 1966.

11097 **Muller, J. E.** (compiler). Glaciation, Kluane Lake, Yukon Territory: Canada Geol. Survey Map 1178A (also in Mem. 340), scale 1:253,440, 1966.

01836 **Multer, H. G.; Milliman, J. D.** Geologic aspects of sabellarian reefs, southeastern Florida [with Spanish abs.]: Bull. Marine Sci., v. 17, no. 2, p. 257–267, illus., tables, 1967.

The tube-building marine polychaete *Phragmatopoma lapidosa* Kinberg produces thick, wave resistant littoral reefs and encrustations along the southeastern coast of Florida. Such deposits tend to stabilize the shore, and by construction of their tubes, sort the local beach sands. Fossil counterparts of similar polychaete tubes in ancient rocks could indicate both proximity to shoreline and the origin of anomalous local sorting.—Authors' abstract

Munk, M. N. *See* Hohenberg, C. M. 01467

01476 **Murata, K. J.; Friedman, I. I.; Madsen, B. M.** Carbon-13-rich diagenetic carbonates in Miocene formations of California and Oregon: Science, v. 156, no. 3781, p. 1484–1486, tables, 1967.

Carbon unusually rich in C-13 ($\delta C\text{-}13 = +5.4$ to $+19.0$ per mil relative to the Peedee belemnite carbonate standard of the University of Chicago) is characteristic of certain diagenetic limestones and dolomites in the Miocene Monterey Shale of California and the Nye Mudstone of Oregon. This heavy carbon may have originated through low-temperature equilibrium between CO_3 and CO_2 in migrating carbonated waters or between CH_4 and CO_2 in natural gas. Light carbon ($\delta C\text{-}13 = -5.6$ to -18.2 per mil) derived through nonequilibrium oxidation of organic matter also occurs in the carbonate of Monterey Shale in some localities, but at most places it is much less common than heavy carbon.—Authors' abstract

01709 **Murphy, Michael A.** The ammonoid subfamily Gabbioceratinae Breistroffer: Jour. Paleontology, v. 41, no. 3, p. 595–607, illus., tables, 1967.

The subfamily Gabbioceratinae includes two genera, *Gabbioceras* Hyatt, and *Jauberticeras* Jacob, from the Middle Cretaceous (Aptian, Albian, and Cenomanian) strata of the Tethyan region, California, and Madagascar. The subfamily is first known from Gargasian rocks in southeastern France, and probably evolved in the earliest Gargasian from the group of variants characterized by *Eogaudryceras numidum*. The *Gabbioceras* of the *G. angulatum* group are interpreted as being the root stock through which *Jauberticeras* and the later *Gabbioceras* of the *G. michelianum* group were evolved.—*from* Author's abstract

01699 **Murray, Frederick N.** Jointing in sedimentary rocks along the Grand Hogback Monocline, Colorado: Jour. Geology, v. 75, no. 3, p. 340–350, illus., 1967.

Removal of strata dip–and–strike effects at each collecting station by rotation in three–dimensions increases resolution of data concerning the orientation of joint surfaces in sedimentary rocks. Contoured equal–area diagrams of unrotated and rotated joints illustrate the changes in joint plane pole maxima. Jointing in sedimentary rocks upturned along two trends of the Grand Hogback Monocline, Colorado, is inferred as being related to vertical uplift rather than to horizontal compression or superposition of a regional joint system. The joints may have been caused by tensional stresses developed within the strata by the inherent slowness of rocks to relax from a prestressed condition created by deep burial.—Author's abstract

01655 **Murray, J. W.** Transparent and opaque foraminiferid tests: Jour. Paleontology, v. 41, no. 3, p. 791, 1967.

Opacity has been produced in foraminiferid tests by post–mortem submergence in solutions ranging in pH from 4.1 to 7.0. White, opaque tests were produced in as little as 4 1/2 hours at pH 4.1 and after 15 days at pH 7.0, with concomitant etching and weakening of the tests. Failure, in the past, to recognize the possible post–mortem genesis of opacity has led to the use of transparency and opacity as a taxonomic character with resultant erroneous identifications.—JFM

Murray, Willard A. *See* Monkmeyer, Peter L. 01797

Myers, W. Bradley. *See* Hamilton, Warren. 01775

01747 **Nace, Raymond L.** Water resources—A global problem with local roots: Environmental Sci. and Technology, v. 1, no. 7, p. 550–560, illus., table, 1967.

The International Hydrological Decade provides the framework for nations to cooperate in studies of water on national, international, continental, and global scales; water resources are a global problem with local roots but hydrological data are either lacking or totally inadequate for two–thirds of the land area and nearly all the water area of the world. Sponsored by UNESCO, the IHD has a coordinating council to guide activities of the 90–odd member states and other UN agencies participating in the program. To compensate for a genuine lack of trained hydrologists, universities are offering more courses and fellowships, UNESCO has a hydrology fellowship program, and several countries have acted to improve their hydrological education. Studies of the world water balance, including snow and ice, will require specific research to close gaps in understanding the water cycle; basic data on all aspects are crucial for the future.—MCM

Nagata, Takesi. *See* Ozima, M. 01487

01785 **Nairn, A. E. M.** Towards the cause of ice ages: Explorer, v. 9, no. 2, p. 16–17, 28, illus., 1967.

There has been no satisfactory explanation of Pleistocene glaciation because of the alternation of ice sheets and interglacial intervals. Temperature fluctuations with a periodicity of tens of thousands of years are represented. The oxygen–18 isotope provides absolute thermometry; curves derived from deep–sea cores correlate with geologic sequences and with curves showing heat fluctuations due to astronomical causes. There was a marked temperature change in the Tertiary, a time of uplift

and orogeny. The writer believes that the ice-age trigger was this uplift of continental blocks; if this is true, we are living in an interglacial.—ESL

Nash, D. B. *See* McKee, E. H. 01373

Nathan, Henry. *See* Siegel, S. M. 01600

Neathery, Thornton Lee. *See* Daniel, Thomas W., Jr. 11076

Nelson, J. G. *See* Brunger, A. G. 01588

01448 **New York State Geological Assoc.; Waines, Russell H.** (editor). Guide to field trips. 39th annual meeting, New Paltz, N. Y., 1967: New York, City Coll. City Univ. New York, Dept. Geology, [144] p., illus., 1967.

This guide book to field trips of New York State is a collection of the trips with accompanying road logs and papers by a number of different authors and field trip leaders. The field trips and papers (cited separately) are concerned with the geomorphology, petrology, stratigraphy, structure, glacial, and economic geology of various parts of the State.—LLP

Newport, T. G. *See* Wiitala, S. W. 01801

01735 **Newton, R. C.; Smith, J. V.** Investigations concerning the breakdown of albite at depth in the Earth: Jour. Geology, v. 75, no. 3, p. 268–286, illus., tables, 1967.

Fine-grained jadeite alterations of detrital sodic plagioclase in several specimens of metasediments from the Franciscan Formation have been analyzed with the electron microprobe. Iron is the major "impurity", ranging from 1 to 8 wt. percent. An "average" jadeite has the composition $Jd_{82}Ac_{14}Di_4$. Surviving albite contains only 0.0–0.1 percent Fe; higher Fe analyses were obtained for albite containing disseminated amphibole, but the analyses probably suffer from overlapping. From analytical and experimental data it is concluded that pressure of 6–8.5 kb are reached in the genesis of some glaucophane schists. Estimates of the extreme thicknesses of geosynclinal sedimentary and volcanic accumulations indicate that an appeal to tectonic overpressure to account for pressures of this magnitude is not necessary.—*from* Authors' abstract

01463 **Nickelsen, Richard P.; Hough, Van Ness D.** Jointing in the Appalachian Plateau of Pennsylvania: Geol. Soc. America Bull., v. 78, no. 5, p. 609–629, illus., table, 1967.

The fundamental joint system in shale and coal of the Pennsylvanian and Permian of Pennsylvania consists of two suborthogonal sets: a dominant, planar, systematic set, and a subordinate, nonplanar, nonsystematic set, which does not cut the systematic set. Systematic joints in shale strike north or northwest grossly transverse to northeast-trending fold axes of the Appalachians; whereas, those in coal in northern Pennsylvania are tangent to a broad, southward convex arc. The systematic joints are extension fractures, formed perpendicular to the axis of least compression early in the same compressive event that produced the folds. Joints probably formed first in the weaker coal, in which their pattern reflects a very early regional stress orientation.—RAL

01382 **Nir, A.** Development of isotope methods applied to groundwater hydrology, *in* Isotope techniques in the hydrologic cycle—Symposium, Univ. Illinois, 1965: Am. Geophys. Union Geophys. Mon. Ser., no. 11, p. 109–116, illus., 1967.

A survey of development of isotope methods in hydrology reveals that only a few defined areas of specific and local application have been advanced, such as determination of point velocity, aquifer storativity, hydrodynamic dispersion coefficients, and transit times through age determination. A critical evaluation of present methods of isotope data interpretation to groundwater analysis indicates that assumptions and results are not compatible with the problems of practicing hydrologists. A more basic contribution of isotope methods requires a more concerted effort in selected hydrological basins where diverse isotope and

conventional methods could be applied and evaluated in close cooperation between hydrologists and physical (isotope) scientists. The present hydrological decade offers a suitable opportunity for such an undertaking on a regional scale.—*from* Author's abstract

01854 **Noble, Donald C.; Krushensky, Richard D.; McKay, Edward J.; Ege, John R.** Geologic map of the Dead Horse Flat quadrangle, Nye County, Nevada: U.S. Geol. Survey Geol. Quad. Map GQ-614, scale 1:24,000, section, 1967.

Norford, B. S. *See* Belyea, H. R. 01614

Norrman, John O. *See* Meland, Nils. 11104

01576 **North Dakota Geological Survey.** List of cores available for study at the North Dakota Geological Survey, Supp. 2: Grand Forks, N. Dak., North Dakota Geol. Survey, 11 p., 1967.

The well name, location, formation cored, cored interval, and storage index are arranged according to the North Dakota Geological Survey well file number system. Most of these cores are either full diameter or split, but in some cases only representative chips are available. The stratigraphic nomenclature is that currently in use by the North Dakota Survey. The original list was published in 1963 and the first supplement in 1965.—GDC

Nuttli, Otto W. *See* Hays, Walter W. 01675

01524 **Ohlhaber, Robert F.** South Cook Field—Lower Wilcox, DeWitt County, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 193–197, illus., tables, 1967.

01711 **Oklahoma Geological Survey.** Bibliography of Louise Jordan: Oklahoma Geology Notes, v. 27, no. 6, p. 107–111, 1967.

01586 **Olmsted, F. H.; McDonald, C. C.** Hydrologic studies of the lower Colorado River region: Water Resources Bull., v. 3, no. 1, p. 45–58, illus., 1967.

The Geological Survey in 1960 began a comprehensive study of the hydrology of the lower reaches of the main Colorado River valley from Davis Dam to the international boundary, and of certain adjacent areas that receive water from the river. The study includes an appraisal of the probable water supply available to the area, consumptive uses by crops, native vegetation, and evaporation, with greatest emphasis on the location and movement of ground water which may be available for development. Although the final results of the study are not yet available, the objectives, scope, methods used, and some preliminary results are described.—Authors' summary

01417 **Olmsted, James Frederick.** Petrology of a differentiated anorthositic intrusion in northwestern Wisconsin [abs.]: Dissert. Abs., Sec. B., Sci. and Eng., v. 27, no. 9, p. 3152B, 1967.

01722 **Olsen, Stanley J.** Miocene vertebrates and north Florida shorelines [abs.], *in* Tertiary sea-level symposium: Coastal Research Notes, v. 2, no. 4, p. 8, 1967.

01905 **Owens, Gordon L.** The Precambrian surface of Ohio: Ohio Div. Geol. Survey Rept. Inv. 64, 8 p., illus., tables, 1967.

The contour map (scale 1:500,000) of the Precambrian surface of Ohio, presented here, is based on geophysical data and drillers' logs from 133 wells; 56 of these wells are in Ohio and 39 are in adjacent states and Ontario. The two most obvious features are the Indiana–Ohio platform ("Cincinnati Arch") in western Ohio and the western limb of the Appalachian geosyncline in eastern Ohio. The hingeline separating these two features may be more geologically important than either flanking structure. Existing evidence suggests at least partial fault control, a factor that may encourage further exploratory well drilling along this hingeline.

Descriptions of more detailed relief, changes in slope, and small fault displacement are summarized. Well penetrations are tabulated.—GDC

01487 **Ozima, M.; Kono, M.; Kaneoka, I.; Kinoshita, Hazimu; Kobayashi, Kazuo; Nagata, Takesi; Larson, E. E.; Strangway, D. W.** Paleomagnetism and potassium–argon ages of some volcanic rocks from the Rio Grande gorge, New Mexico: Jour. Geophys. Research, v. 72, no. 10, p. 2615–2621, illus., tables, 1967.

Successive lava flows exposed in the Rio Grande gorge, near Taos, N. Mex., can be divided into three groups, each of different magnetic polarity: the upper and lower groups have a normal polarity, whereas the middle one has a reversed polarity. K–Ar radiometric ages indicate that the base of the upper normal polarity sequence is about 3.7 m.y. old and that the reversed flows range from 3.7 m.y. to 4.4 m.y. The lowermost normal flow has the K–Ar age of 4.5 m.y. The age difference between the base of the upper normal and the top of the adjacent reversed flow group is about 0.05 m.y., indicating rapid polarity switching.—Authors' abstract

01889 **Paaswell, Robert E.** Temperature effects on clay soil consolidation: Am. Soc. Civil Engineers Proc., v. 93, paper 5225, Jour. Soil Mechanics and Found. Div., no. SM 3, p. 9–22, illus., 1967.

The influence of increasing the temperature in a consolidating soil is examined by consideration of the thermal energy input from the temperature change. This energy provides the potential necessary to cause flow through physical changes in the pore water and at the soil water interface. A consolidometer was adapted to provide temperature changes through a heating element, the temperatures being measured by thermocouples at the soil sample surface. The quantity of deformation induced by increasing boundary temperatures at a given stress level was measured for three series of increases: low–long time, high–long time, and high–rapid time. The magnitude of resulting deformation depended directly on the magnitude of the temperature increase, and the deformation pattern was similar to the temperature pattern.—*from* Author's abstract

01828 **Page, W. Delano.** The National Research Council's Division of Earth Science—Its first 48 years: Geotimes, v. 12, no. 5, p. 15–17, illus., 1967.

The National Research Council was established by the National Academy of Sciences in 1916. In 1919, 15 geologists and geographers organized the Division of Geology and Geography with the promotion of research as its main goal. Its scope now includes education and international matters in earth science. The organization in relation to the adhering societies is described, and work done by the various committees discussed. The achievements of 10 committees, selected from about 150, are given as examples.—ESL

01510 **Pallister, A. E.** How to apply seismic data to western Canada reefs: World Oil, v. 165, no. 2, p. 62–67, illus., 1967.

Facies changes related to fore-reef, reef, and back-reef sediments are described with particular regard to seismic velocities. Methods of correcting for the variation in velocities in reef zones in order to correctly map structure below reef horizons are given.—TAH

01646 **Palmer, Andrew C.** Ice lensing, thermal diffusion and water migration in freezing soil: Jour. Glaciology, v. 6, no. 47, p. 681–694, illus., 1967.

When a surface layer of the soil freezes, both heat and water diffuse from the unfrozen soil beneath to the frozen region. Often the soil does not freeze homogeneously but distinct ice lenses form. An analysis of the diffusion and ice nucleation processes suggests conditions under which ice lensing can be expected; in particular, it is shown that multiple ice lenses cannot form unless the soil thermal diffusivity is greater than the water diffusion coefficient. Analysis of a simple one-dimensional case (a semi-infinite mass of homogeneous soil whose surface temperature is suddenly lowered) gives the temperature and water-content fields as functions of time; these agree with those observed in an experimental study of freezing clay.—Author's abstract

Palmer, Raleigh A. *See* Swingle, George D. 01774

Papadopoulos, John. *See* Sellers, Bach. 01385

01808 **Pararas-Carayannis, George.** A study of the source mechanism of the Alaska earthquake and tsunami of March 27, 1964—Pt. 1, Water waves: Pacific Sci., v. 21, no. 3, p. 301-310, illus., 1967.

The tsunami-generating area of the 1964 Alaskan earthquake is determined to be 140,000 km^2 extending from the Trinity Islands to Bering Glacier and including the continental shelf to a depth of 200 m. Dislocations follow a dipole pattern of positive and negative displacements, with the zero-line intersecting the east coast of Kodiak Island, continuing northeast to Prince William Sound, then east along the upper part of the Sound. Areas north and west of the line underwent negative elevation changes, those east and south, positive. The tsunami-generating area was mostly in the belt of uplift. The volume of crustal displacement and the energy associated with the tsunami are calculated, and the possible generating mechanisms discussed. Wave diffraction diagrams are included.—ESL

01546 **Parker, Lynda.** The paleomagnetism of two diabase dykes of the Whitefish Falls area, Ontario [abs.], *in* New York State Geol. Assoc., Guide book to field trips, 39th Ann. Mtg., New Paltz, N. Y., 1967: New York, City Coll. City Univ. New York, Dept. Geology, p. TK5, 1967.

01838 **Parmalee, Paul W.** *Castoroides* and *Cervalces* from central Illinois: Illinois Acad. Sci. Trans., v. 60, no. 2, p. 127-130, illus., 1967.

Specimens of the Pleistocene giant beaver, *Castoroides ohioensis*, and stilt-legged moose, *Cervalces* sp., are reported from Sangamon County, Illinois.—Author's abstract

Paulson, Q. F. *See* Baker, Claud H., Jr. 01745

01388 **Payne, Bryan R.** Contribution of isotope techniques to the study of some hydrological problems, *in* Isotope techniques in the hydrologic cycle—Symposium, Univ. Illinois, 1965: Am. Geophys. Union Geophys. Mon. Ser., no. 11, p. 62-68, illus., 1967.

The occurrence of environmental tritium and the variations in concentration of deuterium and O^{18} have been applied to the solution of some hydrological problems. Examples are given of field studies in which information has been obtained on the turnover time of lakes, the interconnections between different water bodies, the location of recharge areas, and the transit times since recharge. The results are discussed in relation to the hydrology of the areas.—Author's abstract

Payne, J. L. *See* Dickas, A. B. 01633

01729 **Pearson, Frederick Joseph, Jr.** Ground-water ages and flow rates by the carbon-14 method [abs.]: Houston Geol. Soc. Bull., v. 9, no. 10, p. 22, 1967.

01887 **Peck, Ralph B.** Stability of natural slopes: Am. Soc. Civil Engineers Proc., v. 93, paper 5323, Jour. Soil Mechanics and Found. Div., no. SM 4, p. 403-417, illus., 1967.

The significance of progressive failure in slides of natural or cut slopes is reviewed and qualitative methods for taking it into account are discussed. Nevertheless, it is concluded that present procedures do not permit reliable assessment of the factor of safety of natural or cut slopes under most conditions encountered in practice. This conclusion is illustrated by the history of a landslide that destroyed the Lower Baker Power Plant near Seattle [Wash.]. The failure occurred while the sliding mass was thought to be temporarily under control although remedial measures were being planned. The reliability of predictions is enhanced in old landslide areas, provided the existence of the old slide material is recognized.—Author's abstract

01817 **Pelletier, B. R.** Several projects study geology on Sable Island: Oilweek, v. 18, no. 19, p. 45–47, 64, illus., 1967.

The drilling of a deep test hole on Sable Island, at the edge of the continental shelf 180 miles east of Halifax, Nova Scotia, is only part of the geological exploration being conducted in that area. Aimed at penetrating 15,000 feet of unconsolidated sediments and bedrock, it will be the deepest drill hole in the Atlantic provinces. A review of research designed to unearth the secrets of the bedrock, underway in the vicinity since 1954, includes geophysical exploration on the continental shelf by seismic and magnetic surveys, and dredging and coring operations from a submarine canyon called the Gully, 30 miles east of Sable Island. These rocks are presumed to be Tertiary and their foraminiferal fauna is similar to types found on Georges Bank.—GDC

01850 **Peterson, Warren L.** Geologic map of the Lebanon Junction quadrangle, central Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ–603, scale 1:24,000, section, text, 1967.

Tests show that locally shale in the basal part of the Borden Formation is suitable for brick, tile, and lightweight aggregate. Lacustrine and silty clay have possible limited uses.—MCM

01704 **Pettitt, John M.; Beck, Charles B.** Seed from the Upper Devonian: Science, v. 156, no. 3783, p. 1727–1729, illus., 1967.

We present evidence proving the existence of seeds in the Upper Devonian and extending the known age of seed plants from the Lower Carboniferous (Mississippian) into the Upper Devonian.—Authors' abstract

01712 **Pettyjohn, Wayne A.** Multiple drift sheets in southwestern Ward County, North Dakota, *in* Glacial geology of the Missouri Coteau—Midwest Friends of the Pleistocene, Field Conf. 1967, Guidebook: North Dakota Geol. Survey Misc. Ser. 30, p. 123–129, illus., 1967.

The Coteau du Missouri in Ward County appears to consist of a bedrock "high" overlain by at least two end moraines, ground moraine, and an abundance of dead-ice moraine. At least two drift sheets are present and they differ considerably in age. The younger Makoti, Ryder, and Martin deposits have been dated by radiocarbon methods as 10,300±300 and 10,350±300 B.P. The upper surface of the older Blue Mountain drift sheet has been oxidized and this zone can be traced in the subsurface over wide areas. Inconclusive data suggest that the Blue Mountain drift sheet is early Wisconsin and that the buried oxidized zone represents the Farmdale Stage.—Author's summary

01740 **Pettyjohn, Wayne A.** Dump ridges and collapsed sub-ice channels in Ward County, North Dakota, *in* Glacial geology of the Missouri Coteau—Midwest Friends of the Pleistocene, Field Conf. 1967, Guidebook: North Dakota Geol. Survey Misc. Ser. 30, p. 115–116, illus., 1967.

Dump ridges which are relatively common in Ward County are formed by the dumping of outwash, usually boulders and gravel, at the edges of stagnant ice fields. Commonly found perpendicular to the ridges are collapsed sub-ice channels which were filled with superglacial drift as the ice melted.—LLP

01800 **Pettyjohn, Wayne A.** Geohydrology of the Souris River valley in the vicinity of Minot, North Dakota: U.S. Geol. Survey Water-Supply Paper 1844, 53 p., illus., tables, geol. map, 1967.

The Minot area of the Souris River valley in north-central North Dakota is covered primarily by late Wisconsin glacial drift averaging 100 feet in thickness. Although six glacial aquifers were studied, only the Minot aquifer was examined in detail; it is a thick deposit of sand and gravel recharged from buried glaciofluvial deposits and from the Souris River. The water level has declined more than 70 feet since 1916 and more than 20 feet in some places during 1961–1963. This rapid decline

could be counteracted by artificial recharge; several possible recharge sites of highly permeable sand and gravel crop out in the western Minot area.—LLP

Philpotts, A. R. *See* Clarke, T. H. 01432

01832 **Phleger, Fred B.; Bradshaw, John S.** Quantitative measures of sedimentary environments in marine marshes [abs.]: Coastal Research Notes, v. 2, no. 5, p. 7–8, 1967.

Pinckney, D. J. *See* Wershaw, R. L. 01391

01528 **Plant, Charles E.** Marshall Field (Wilcox), Goliad County, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 124–128, illus., tables, 1967.

01799 **Plate, Erich J.** Spectral analysis of sand waves—Discussion [of paper 4910 by C. F. Nordin, Jr. and J. H. Algert, 1966]: Am. Soc. Civil Engineers Proc., v. 93, paper 5304, Jour. Hydraulics Div., no. HY 4, p. 310–316, illus., 1967.

In reference to paper 4910 (ibid., v. 92, no. HY 5, p. 95–114, 1966), methods of time series analysis are used to obtain an "average waveform" for wind-generated waves in a laboratory channel. The method may also be used for the determination of the characteristic wave form of a sediment.—LLP

11088 **Platt, Rutherford.** The great American forest: Englewood Cliffs, N. J., Prentice-Hall, 271 p., illus., 1966.

Chapters in this popular account cover: (1) earliest man on the North American continent and history of forests he found; (2) Bering land bridge and men who crossed it contrasted with later discoverers; (3) early forests including a Cretaceous fossil flora from the Aternakerdluk area, Greenland, stumps and fossils of fern trees at Gilboa, N. Y., and history of hardwood forests in New England (resembling those in Asia), involving continental drift and Pleistocene glaciation; (4) evolution of the deciduous forest during Pleistocene; (5–15) botanical aspects of forests; and (16) mountain and coastal forests, including volcanoes of the west coast.—ESL

Pomeroy, Paul W. *See* Sutton, George H. 01513

01743 **Ponnamperuma, F. N.; Tianco, Estrella M.; Loy, Teresita.** Redox equilibria in flooded soils—[Pt.] 1, The iron hydroxide system: Soil Sci., v. 103, no. 6, p. 374–382, illus., table, 1967.

The Eh, pH, and Fe activity of the solutions of 32 flooded soils, sampled weekly for 17 weeks, conformed remarkably closely to $Eh = 1.058 - 0.059 \log Fe - 0.177\ pH$; and to $Eh = 1.373 - 0.0885 \log Fe - 0.236\ pH$ and $Eh = 0.429 - 0.059\ pH$ especially after the peak of water-soluble Fe. This confirms the participation of $Fe(OH)_3$ and $Fe(OH)_8$ in redox equilibria in flooded soils.—JWH

01418 **Pope, John Keyler.** Comparative morphology and shell histology of the Ordovician Strophomenacea (Brachiopoda) [abs.]: Dissert. Abs., Sec. B., Sci. and Eng., v. 27, no. 9, p. 3152B–3153B, 1967.

01545 **Porter, Charles O.** Electrical resistivity investigations over limestone caverns in eastern New York [abs.], *in* New York State Geol. Assoc., Guide book to field trips, 39th Ann. Mtg., New Paltz, N. Y., 1967: New York, City Coll. City Univ. New York, Dept. Geology, p. TK5, 1967.

01631 **Post, Austin.** Walsh Glacier surge, 1966 observations: Jour. Glaciology, v. 6, no. 47, p. 763–765, illus., 1967.

The surge of Walsh Glacier observed between 1961 and 1965 (Post, 1966) has continued in 1966 with the greatest change in the terminal region. Movement of Logan Glacier below its junction with Walsh Glacier has been completely reactivated and Logan Glacier has thrust ahead about 1,500 m at its terminus. Movement of upper Walsh Glacier has been less than in the lower valley in the past year.

Increased activity noted at three other glaciers in the vicinity of Walsh in 1966—Baldwin, first tributary of Logan Glacier east of Baldwin, and the valley glacier west of Baldwin—may be the beginning of surges. Anderson Glacier, the major source for Chitina Glacier, also is moving more rapidly than in 1960.—VSN

01826 **Post, Donald F.; White, Joe L.** Clay mineralogy and mica-vermiculite layer charge density distribution in the Switzerland soils of Indiana: Soil Sci. Soc. America Proc., v. 31, no. 3, p. 419–424, illus., table, 1967.

A study was made of the weathering of mica inherited from Ordovician limestone and calcareous shales in two Switzerland soils, which belong to the Typic Normudalf, fine mixed mesic family. X-ray and physicochemical studies of the clay fraction showed that the solum of Switzerland I had an average of 24 percent mica and 35 percent vermiculite and the solum of Switzerland II was 40 percent mica and 24 percent vermiculite. Layer charge density clearly showed the decrease in charge density moving from the parent material upward in the soil profiles. The degree of swelling of the vermiculite on solvation was a function of this charge density.—*from* Authors' abstract

11063 **Potter, Paul Edwin; Scheidegger, Adrian E.** Bed thickness and grain size—Graded beds: Sedimentology, v. 7, no. 3, p. 233–240, illus., tables, 1966.

Data from Ordovician [Pennsylvania] and Tertiary [Spain and France] turbidites and from the Hekla ash fall [Iceland] show good correlation between bed thickness and grain size. Most of the thicker beds are coarser grained. The relation between bed thickness and grain size in graded beds can be explained by a theory which uses a sedimentation formula based on the decay law of turbulence in the deposition zone of a turbidity current.—Authors' summary

01460 **Poulsen, Valdemar.** Ordovician at Sukkertoppen [abs.]: Dansk Geol. Foren. Medd., v. 17, no. 1, p. 146, 1967.

Pourade, James S. *See* Rogers, Malcolm J. 11093

01442 **Pratt, Walden P.** Geology of Hurley West quadrangle, Grant County, New Mexico: U.S. Geol. Survey Bull. 1241-E, p. E1–E91, illus., tables, geol. map, 1967.

The Hurley West quadrangle is in the southern part of the Silver City mining region. Lone Mountain, the dominant feature, contains 2,300 feet of well-exposed beds from the Cambrian and Ordovician Bliss Sandstone through the Mississippian Lake Valley Limestone, and 1,700 feet of less well-exposed upper Paleozoic and Cretaceous rocks. Miocene(?) volcanic rocks are exposed in one corner of the quadrangle; most of the remainder is underlain by three facies of Pliocene and Pleistocene Gila Conglomerate. Offsets of Paleozoic and Cretaceous strata and their relations to intrusions record a complex history of early Tertiary faulting and intrusion. Silver and manganese ore deposits appear to be largely mined out, except for a possible manganese ore area.—WPP

01386 **Preiss, Kenneth.** Design of a neutron scattering water content gage for soils, *in* Isotope techniques in the hydrologic cycle—Symposium, Univ. Illinois, 1965: Am. Geophys. Union Geophys. Mon. Ser., no. 11, p. 22–27, illus., 1967.

Errors in the reading of a neutron scattering water content gage due to the chemical composition of the soil and to statistical fluctuations in the source emission rate are discussed. The effect of each cause of error may be minimized by correct design of the apparatus. The collision processes that may occur between neutrons and the atoms of a soil are described. It is shown that trace quantities of particular elements in the soil can reduce the reading, but a simple cadmium cover around the detector will eliminate their effect. Equations are given relating error in water content reading with the ordinate and slope of the calibration curve. Using these equations, it is shown that the time required to attain a given standard error in water content reading depends upon the distance between source and detector; a source to detector distance exists which gives a least time for a given error. Author's abstract

01802 **Price, Don.** Geology and water resources in the French Prairie area, northern Willamette Valley, Oregon: U.S. Geol. Survey Water-Supply Paper 1833, 98 p., illus., tables, geol. map, 1967.

The French Prairie area is part of a northeast-trending synclinal trough, partly filled with Pliocene to Recent nonmarine deposits which provide the principal groundwater reservoir. Gravels of the Pliocene Troutdale Formation and Recent alluvium of the Willamette River are the most permeable aquifers. Because the reservoir is recharged by downward percolation of precipitation, the water table declines 5–20 feet during the dry summer months. Ground water pumpage increased from about 150 irrigation wells in 1950 to nearly 600 in 1963. If withdrawal is increased from the estimated 20,000 acre-feet in 1960 to 100,000 acre-feet per year, the water table will be lowered a few feet to a few tens of feet. After the initial adjustment, no further decline would be expected.—LLP

01901 **Prych, Edmund A.; Hubbell, David W.; Glenn, Jerry L.** New estuarine measurement equipment and techniques: Am. Soc. Civil Engineers Proc., v. 93, paper 5219, Jour. Waterways and Harbors Div., no. WW 2, p. 41–58, illus., reprinted 1967; originally published 1966.

This paper was originally published *in* Coastal engineering, Santa Barbara Specialty Conf. 1965, by the American Society of Civil Engineers, 1966. (See Abstracts of North American Geology for August 1967.)—LLP

01401 **Psuty, Norbert Phillip.** The geomorphology of beach ridges in Tabasco, Mexico [abs.]: Dissert. Abs., Sec. B., Sci. and Eng., v. 27, no. 9, p. 3141B, 1967.

01668 **Putman, G. W.; Alfors, J. T.** Frequency distribution of minor metals in the Rocky Hill stock, Tulare County, California: Geochim. et Cosmochim. Acta, v. 31, no. 3, p. 431–450, illus., tables, 1967.

To provide information on the distribution of minor metals in a relatively well defined and chemically simple granitic body, 151 samples collected on a grid on the Rocky Hill granodiorite stock in Tulare County, Calif., were investigated. The results suggest that cumulative frequency plots represent a satisfactory empirical description of the lognormal (continuous) distribution as applied to element distribution in mineral phases of granitic rocks.—DBV

01603 **Pye, E. G.** Lac des Iles sheet, Thunder Bay District: Ontario Dept. Mines Map 2135, scale 1:31,680, 1967.

01604 **Pye, E. G.** Max Lake sheet, Thunder Bay District: Ontario Dept. Mines Map 2136, scale 1:31,680, 1967.

01397 **Qashu, H. K.; Buol, S. W.** Hydraulic and micromorphological properties of stream channel sediments: Water Resources Research, v. 3, no. 2, p. 465–469, illus., table, 1967.

In arid and semiarid regions of southwestern United States, a large portion of natural water recharge is through channel beds and alluvial deposits in river basins. Water transmission varies with time, location, depth and extent of alluvium, and hydraulic characteristics of flows, sediment loads, and morphology of channels. An alluvial profile in an ephemeral stream channel had layers with relatively high clay and silt accumulation. Micromorphological examination of a sample found clay and silt accumulated on sand and gravel particles and around aggregates. In the laboratory the hydraulic conductivity of disperse and remixed material was 30 percent less than that for a nondispersed sample, which is attributed to the orderly arrangement of clay and silt on surfaces and between larger sand and gravel particles of nondispersed samples.—*from* Authors' abstract

Qualls, B. R. *See* Tryggvason, Eysteinn. 01596

01558 **Rader, Eugene K.** Geology of the Staunton, Churchville, Greenville, and Stuarts Draft quadrangles, Virginia: Virginia Div. Mineral Resources Rept. Inv. 12, 43 p., illus., tables, geol. maps, 1967.

In the Staunton, Churchville, Greenville, and Stuarts Draft quadrangles, in Augusta County, Virginia, the bedrock is of Middle Cambrian to Late Devonian age, is largely sedimentary and totals 20,000 feet in thickness. The igneous rocks are generally diabase, nepheline syenite, teschenite–syenite, and teschenite–picrite. The Massanutten synclinorium in the east is an area of folds and thrust faults. Northwest of the synclinorium are the Pulaski–Staunton and the North Mountain thrust faults. Mineral resources consist of limestone and dolomite which are currently quarried for crushed stone; bauxite and iron ore, both of which have been produced in the area; and shales and residual clays which have been tested for potential use in the brick and ceramic industries.—LLP

01686 **Ramsay, John G.** Folding and fracturing of rocks: New York, McGraw–Hill Book Co. (Internat. Ser. Earth and Planetary Sci.), 568 p., illus., tables, 1967.

This book outlines the basic theories of stress, strain, and the properties of rock materials, and considers some of their implications in geological processes. The basic ground work, explained in elementary mathematical terms, leads to a study of fracture and flow and the geological aspects of fracturing and folding of rock materials which, it is hoped, will supplement textbooks of descriptive structural geology. Examples of specific regions illustrate the particular structural phenomena discussed; diagrammatic aides are included. Chapters include methods of analysis, basic mathematical models, various types of folds, deformed unconformities and sedimentation structures, and repeated and superimposed folding.—GDC

01804 **Rappleyea, C. Annette.** Crater, ejecta, and air–blast studies from five high explosive charges in a horizontal square array: Sandia Corp. Labs., Albuquerque, N. Mex., Rept. SC–RR–66–480, 159 p., illus., tables, 1967.

Fifteen arrays of 64–pound charges, one of 8–pound charges, and one of 256–pound charges of cast TNT were fired in a dry–lake playa at the Tonopah Test Range, Nevada, as part of Project Plowshare. The apparent crater volume for the 64–pound array charges was about three times as big as from a single 320–pound charge, and the radius was 1.5 times as big. These results are expected to be applicable to nuclear explosives, using appropriate scaling laws. This array could be used to level large amounts of land, to excavate for mining, or to build canals and harbors. An appendix containing crater photographs, topographic maps, and cross sections comprises almost half the report.—ESL

01457 **Raunsgaard Pedersen, K.** Nogle präkambriske fossiler fra Vestgrönland [summ.]: Dansk Geol. Foren. Medd., v. 17, no. 1, p. 195–196, 1967.

01707 **Raup, David M.; Chamberlain, John A., Jr.** Equations for volume and center of gravity in ammonoid shells: Jour. Paleontology, v. 41, no. 3, p. 566–574, illus., tables, 1967.

The equations of Moseley for volume and center of gravity of the ideal, planispiral cephalopod shell may be used effectively, in modified form, with actual specimens. The equation for shell volume suggested by Trueman is subject to systematic errors dependent on coiling geometry. The volume and center of gravity equations are useful in theoretical analysis of the general relations between shell geometry and biological factors such as body chamber length and attitude in the life position. Equations are presented that make it possible to evaluate these factors over a wide range of hypothetical shell forms. Use of digital computers in all calculations is a practical necessity.—*from* Authors' abstract

01710 **Ray, Clayton E.; Cooper, Byron N.; Benninghoff, William S.** Fossil mammals and pollen in a late Pleistocene deposit at Saltville, Virginia: Jour. Paleontology, v. 41, no. 3, p. 608–622, illus., 1967.

Late Pleistocene mammals have been known from Saltville, Va., since as early as 1782. The Saltville Valley is underlain by the Mississippian Maccrady Formation, which is the major source of the fossiliferous gray mucks of the valley floor, and of the salts which attracted large mammals to springs in the valley. The pollen spectrum, dominated by *Pinus and Picea*, is interpreted as representative of spruce parkland. The vertebrate fauna includes nine forms: *Megalonyx jeffersonii and/or*

M. dissimilis; Mammut americanum; Mammuthus primigenius; Rangifer tarandus; Symbos cavifrons; and undetermined species of (?)*Cervalces, Equus, Bison, Bootherium*. The species of *Rangifer, Symbos, Bootherium*, are new to Virginia and represent new southeasterly extensions.—*from* Authors abstract

Reams, Max W. *See* Siegel, Frederic R. 11061

Redfield, Alfred C. *See* Friedman, Irving. 01380

Reed, Charles A. *See* Turnbull, William D. 01693

Reese, D. L. *See* Reynolds, M. B. 01610

01580 **Reese, Donald L.; Reynolds, Martin B.** Panther Reef Field, Calhoun County, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 151–155, illus., tables, 1967.

01419 **Reesman, Arthur Lee.** A study of clay mineral dissolution [abs.]: Dissert. Abs., Sec. B., Sci. and Eng., v. 27, no. 9, p. 3153B, 1967.

01472 **Reid, Arch M.; Cohen, Alvin J.** Some characteristics of enstatite from enstatite achondrites: Geochim. et Cosmochim. Acta, v. 31, no. 4, p. 661–672, illus., tables, 1967.

The nine known enstatite achondrite meteorites contain very similar mineral assemblages indicative of formation in a strongly reducing environment. Their major mineral phase is enstatite with an abnormally low content of iron. Luminescence of the enstatite is apparently allowed by the low iron content and influenced by the concentration of manganese. Most of the enstatite achondrites have been brecciated and the pyroxene severely deformed. Deformation has resulted in the conversion of some enstatite to clinoenstatite and may also be responsible for the presence of disordered enstatite.—Authors' abstract

01728 **Reso, Anthony.** Oil shale an important future source of energy [abs.]: Houston Geol. Soc. Bull., v. 9, no. 10, p. 19–20, 1967.

Reynolds, J. H. *See* Hohenberg, C. M. 01467

01610 **Reynolds, M. B.; Reese, D. L.** Chevron Field, offshore Kleberg County, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 43–49, illus., tables, 1967.

Reynolds, Martin B. *See* Reese, Donald L. 01580

Reynolds, Robert C. *See* Lange, Ian M. 11110

01720 **Richards, Horace G.** Tertiary history of the Atlantic Coast between Cape Cod and Cape Hatteras [abs.], *in* Tertiary sea-level symposium: Coastal Research Notes, v. 2, no. 4, p. 7, 1967.

01527 **Richter, D. H.** Person Field, Karnes County, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 156–160, illus., tables, 1967.

01529 **Richter, D. H.; Major, C. F.** Helen Gohlke and West Helen Gohlke Fields, DeWitt and Victoria Counties, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 71–75, illus., tables, 1967.

Ridlon, James B. *See* Scholl, David W. 01491

Riedel, William R. *See* Ross, David A. 01803

01691 **Rigby, J. Keith.** Two new early Paleozoic sponges and the sponge-like organism, *Gaspespongia basalis* Parks, from the Gaspé Peninsula, Quebec: Jour. Paleontology, v. 41, no. 3, p. 766–775, illus., 1967.

Over fifty specimens of the sponge, *Malumispongium hartnageli* (Clarke), one of the largest Paleozoic sponges known, are described from New York State Museum collections from the Silurian La Vieille Formation at Black Cape, north shore of Chaleur Bay. The new genus *Malumispongium*, new family Malumispongiidae, and new superfamily Malumispongioidea, are based on these forms. Two specimens of the sponge, *Calycocoelia solenos*, n.sp., family Anthaspidellidae, are described from the Ordovician Whitehead Formation at Percé. *Gaspespongia basalis* Parks, 1933, was originally described from the La Vieille Formation at Black Cape as a calcareous sponge. Review of type material indicates that it is a stromatolitic alga.—Author's abstract

01605 **Roberts, John.** Theoretical amplitudes and travel times of explosion-generated seismic P waves: California Univ., Livermore, Lawrence Radiation Lab. Rept. UCRL-50232, 10 p., illus., table, 1967.

Amplitudes and traveltimes have been calculated for the first half-cycle of seismic P waves generated by nuclear explosions at distances varying from 140 to 2900 km. The head-wave–body-wave model constructed yields travel times within ±3.9 sec of the mean experimental values over the indicated range of distances and also provides an interpretation of the large-small-large nature of the amplitudes.—Author's abstract

Roberts, Karen. *See* Siegel, S. M. 01600

Robinson, G. B., Jr. *See* Carpenter, C. H. 01810

01490 **Robinson, G. D.; Marvin, R. F.** Upper Cretaceous volcanic glass from western Montana: Geol. Soc. America Bull., v. 78, no. 5, p. 601–608, illus., tables, 1967.

Rhyodacite perlite welded tuff at Three Forks, Montana, yields K–Ar dates on biotite and labradorite phenocrysts of 74±m.y. Glass groundmass is anomalously young. Glassy rocks of comparable age occur near Wolf Creek and Maudlow, Montana.—JJH

11111 **Robison, Richard A.** Geology and coal resources of the Tropic area, Garfield County, Utah: Utah Geol. and Mineralog. Survey Spec. Studies 18, 47 p., illus., tables, geol. map, 1966.

The Tropic area lies within the Colorado Plateau province in southwestern Garfield County. Tributaries of the Paria River are eroding flat or gently folded sedimentary strata and pirating drainage from the East Fork of the Sevier River. Less resistant strata are eroded to broad valleys and more resistant strata form steep slopes and high cliffs. All geologic systems from Jurassic to Quaternary are exposed, and Mississippian to Jurassic systems are known from drill holes. Coal occurs in the Cretaceous Dakota Formation and Straight Cliffs Sandstone. The Henderson coal zone is a 10- to 50-ft section in the lower part of the Straight Cliffs Sandstone. Reserves of the generally subbituminous A to high-volatile C bituminous coal are estimated at about 950 million short tons. Other mineral resources include bentonite, gravel, gas, and oil.—LLP

Robson, G. R. *See* Shepherd, J. B. 01516

01877 **Rochkind, Mark M.** Infrared analysis of gases—A new method: Environmental Sci. and Technology, v. 1, no. 5, p. 434–435, 1967.

In a sensitive method for infrared chemical analysis based on a cryogenic sampling technique (Rochkind, 1967), diluted gas mixtures are deposited in pulses onto a cooled alkali halide substrate; sample preparation and deposition need require only seconds. Extraordinarily simple spectra superbly suited for digital analysis result. Computer analysis of the raw spectral data suggests applications in the areas of air pollution control and atmospheric research. Spectral data for hundreds of gases might be stored within a central computer linked via telephone to numerous experimental stations. Transmitted data could be analyzed in seconds and a report communicated to a local station within minutes. Modifications of the sampling technique to accomodate liquids and solids seem possible.—*from* Author's abstract

01835 **Rochon, R. W.** Relationship of mineral composition of shales to density: South Texas Geol. Soc. Bull., v. 7, no. 7, p. 2–11, illus., 1967.

Density interpretation from electric logs of shales is being used for predicting high pressure in wells. The interface between consolidated and unconsolidated shales, caused by change in deposition rate and in mineralization, may be the beginning of a geopressure zone. The basic cause of high pressure is the sealing of the formation which prevents vertical movement of water during deposition of an overburden; pressure probably increases after the seal has formed. Possibly most pressure zones are only partially sealed so that pressure is relieved at a slower rate, decreasing with depth. Compaction is a function of both time and pressure.—ESL

01553 **Rodgers, John.** Unusual features of the New York sector of the Appalachian Mountains, *in* New York State Geol. Assoc., Guide book to field trips, 39th Ann. Mtg., New Paltz, N. Y., 1967: New York, City Coll. City Univ. New York, Dept. Geology, p. 1–4, 1967.

The New York sector is unusual because it includes much of a major recess in the chain notable for the angular intersection of structural trends and also for extreme horizontal transport along the northwest margin of the chain's metamorphic core. Moreover, the angularity may have been produced by the overlapping and crossing of orogenic trends produced at several different times in the Paleozoic. Probably the first geologist to emphasize the angularity was Arthur Holmes, who used it as an argument for continental drift, for he saw the westward convergence of Caledonian and Hercynian trends in the British Isles finally completed by their crossing in the New York recess where the polarity of orogenic migration during the Paleozoic reverses.—Author's summary

01873 **Roeder, Dietrich Hans.** Rocky Mountains—Der geologische Aufbau des kanadischen Felsengebirges [with English abs.]: Berlin, Gebrüder Borntraeger (Beiträge zur Regionalen Geologie der Erde, V. 5), 318 p., illus., 1967.

The Canadian Rocky Mountains, as a result of 70 years of exploration, are one of the best understood systems of the world. Regional divisions from east to west are the Foothills belt, the Front Ranges, the Central Ranges, the post-Laramide Trench, and more complex western ranges; the Foothills and Front Ranges may be further divided into five structural subdivisions. The mountain chain is characterized by Proterozoic to Silurian, Middle Devonian to Upper Jurassic, and Lower Cretaceous to mid-Tertiary stratigraphic cycles. Tectonic features included structural zonation, nappes, stacks of thrust plates, and various types of faults and folds. In paleogeographic theory the Rockies are the foreshortened extension of geotectonic elements of the Western Canada basin. Mineral resources are reviewed.—GDC

11093 **Rogers, Malcolm J.; Pourade, James S.; Wormington, H. M.; Davis, E. L.; Brott, Clark W.** Ancient hunters of the Far West: San Diego, Calif., Union-Tribune Publishing Co., 208 p., illus., 1966.

The three phases of the San Dieguito Complex of early man are described as found in various sites, and the history, boundaries, and terminology set forth. Present knowledge concerning man's appearance in North America is summarized; the San Dieguito people seem to have come into the area about 9000 B.C. Methods of dating archeological sites are presented; artifacts, tools, and weapons are described and illustrated.—ESL

Rondot, Jehan. *See* Lasalle, Pierre. 01427

11101 **Rosa, Felipe; Brookins, Douglas G.** The mineralogy of the Stockdale kimberlite pipe, Riley County, Kansas: Kansas Acad. Sci. Trans., v. 69, nos. 3–4, p. 335–344, illus., tables, 1966.

The mineralogy of the Stockdale kimberlite pipe has been investigated by petrographic and X-ray diffraction methods. Primary minerals include olivine, clinopyroxene, orthopyroxene, ilmenite, pyrope, phlogopite, apatite, chromite, and possibly some carbonate minerals. The olivine and pyroxenes have been

serpentinized and partially replaced by calcite and/or dolomite. The ilmenite has been partially leucoxenized, the pyrope partially kelyphitized, and the phlogopite partially chloritized and altered to vermiculite. Carbonates have replaced part of the grains and fill fractures within them. Magnetite occurs as a secondary mineral which formed during serpentinization. Other secondary minerals include perovskite, rutile, quartz, hematite, limonite, biotite, amphibole, zircon, and chalcedony. Most carbonate minerals have been derived from surrounding limestone-rich country rocks.—*from* Authors' abstract

01664 **Rose, Arthur W.** Trace elements in sulfide minerals from the Central district, New Mexico and the Bingham district, Utah: Geochim. et Cosmochim. Acta, v. 31, no. 4, p. 547–585, illus., table, 1967.

Results of spectrometric analysis of 373 samples of chalcopyrite and sphalerite from various ores from the Central and Bingham districts suggest: (1) Solid diffusion at 300–500°C is not effective in attaining homogeneous distribution of trace elements; (2) the trace element content of the sulfides being deposited changed in time; (3) several factors are necessary to explain the lack of correlation between trace elements; (4) on the basis of trace element content, geographic location, and geologic occurrence, the samples can be divided into groups representing deposition by separate surges of ore fluid; (5) there is lateral and vertical zoning within some groups; (6) the partition of elements between sulfides shows no correlation with temperature or geologic features.—DBV

01671 **Rosenberg, P. E.; Burt, D. M.; Holland, H. D.** Calcite-dolomite-magnesite stability relations in solutions—The effect of ionic strength: Geochim. et Cosmochim. Acta, v. 31, no. 3, p. 391–396, illus., tables, 1967.

The effect of total solution concentration on the Ca:Mg ratio at the magnesite-dolomite and dolomite-calcite boundaries in $CaCl_2$-$MgCl_2$-CO_2 solutions has been determined between 280° and 420°C. Below about 410° a decrease in the total concentration of the solutions produces a displacement of both boundaries toward lower values of the Ca:Mg ratio. Observed displacements are small but increase with decreasing temperature.—Authors' abstract

01594 **Rosenkrans, R. R.; Marr, John D.** Modern seismic exploration of the Gulf Coast Smackover trend: Geophysics, v. 32, no. 2, p. 184–206, illus., 1967.

Modern seismic methods demonstrate the existence of consistent diagnostic primary reflections from the deep Lower Cretaceous formations, from key Jurassic formation boundaries and from the base of the salt along the Smackover trend across Texas, Louisiana, and Mississippi, thus permitting the first realistic delineation of deep subsurface structure. Typical seismic data are related to subsurface geology. Certain new concepts in salt tectonics along this trend are indicated. Optimum evaluation of Smackover prospects requires determination of age, cause, and magnitude of Smackover closures (including rim synclines if present) plus, if possible, detection of reef buildups.—DBV

01790 **Ross, Charles A.** Late Paleozoic Fusulinacea from northern Yukon Territory: Jour. Paleontology, v. 41, no. 3, p. 709–725, illus., table, 1967.

Late Chesterian (Mississippian) or early Morrowan (Pennsylvanian) to Leonardian (Permian) fusulinids from 42 collections in northern Yukon Territory represent seven fusulinid assemblages. The fusulinid fauna includes *Pseudoendothyra britishensis* n.sp., *P. keelensis* n.sp., *Millerella porcupinensis* n.sp., *Pseudostaffella ettrainensis* n.sp., *P. yukonensis* n.sp., *Endothyra arctica* n.sp., *Fusulinella crowensis* n.sp., *Boultonia yukonensis* n.sp., *Staffella junglensis* n.sp., *Schwagerina jenkinsi* Thorsteinsson, *S. hyperborea* (Salter), *Eoparafusulina yukonensis* (Skinner and Wilde) and other unnamed species of *Brunsia, Staffella, Pseudostaffella, Endothyra, Bradyina, Climacammina, Schwagerina.*—Author's abstract

01803 **Ross, David A.; Riedel, William R.** Comparison of upper parts of some piston cores with simultaneously collected open-barrel cores: Deep-Sea Research, v. 14, no. 3, p. 285–294, illus., table, 1967.

Although some marine geologists have reported that open-barrel gravity cores are shortened relative to the upper sections of simultaneously collected piston cores, the opposite relationship is shown by virtually all correlatable pairs of the two types of cores collected in recent years by the Scripps Institution of Oceanography. This inconsistency is apparently due to slight differences in the coring apparatus or technique used by the various workers. Because of these differences, no simple correction factors can be used to convert measured lengths in recovered cores to *in situ* distances below the sediment surface. The effects of the coring process on the mass physical properties of the sediments in three simultaneously collected open-barrel gravity and piston core-pairs are evaluated.—Authors' abstract

01694 **Ross, June Phillips.** Champlanian Ectoprocta (Bryozoa), New York State: Jour. Paleontology, v. 41, no. 3, p. 632–648, illus., tables, 1967.

Three trepostome genera (*Eridotrypa* Ulrich, *Bythopora* Miller and Dyer, and *Newportopora* n.gen.) and one cryptostome genus (*Crownopora* n.gen. of the family Crownoporidae n.fam.) are well represented in the Champlanian. Based on Kay's stratigraphic correlation of the New York Ordovician, only *E. crownensis* is predominantly Blackriveran, and the remainder—*E. mutabilis* Ulrich, *N. typicalis* n.sp., *B. dendrina* (James), and *C. singularis* n.sp.—are essentially Trentonian in age. *E. mutabilis and B. dendrina* form an extensive assemblage in the Trentonian. In the evolution of the trepostome family Aisenvergiidae, *Eridotrypa and Newportopora* appear to be descendants of the Chazyan *Lamottopora* Ross.—*from* Author's abstract

01398 **Roy, J. L.** À propos du magnétisme des couches rouges de l'est du Canada [reply to discussion of 1966 paper by A. Larochelle]: Canadian Jour. Earth Sci., v. 4, no. 3, p. 574–577, 1967.

In reference to Larochelle's criticism (ibid., v. 3, no. 5, p. 730–733, 1966) of Roy's article (ibid., v. 3, no. 2, p. 139–161, 1966), Roy attempts to clarify some of the confusion. Roy divides his results into two distinct groups: those obtained after demagnitization, and those proceeding from natural remanent magnetization. Secondary magnetization probably contributes to a displacement of $<10°$ for many of the poles. The use of the X^2 test is discussed, and the results obtained from 39 or 42 localities are compared. At three of the 42 localities the directions were distributed at random. It is also stated that displacement is not affected by an error of 3° because it is caused by an error of orientation which remains the same before and after demagnetization.—LLP

01637 **Royse, Chester F.; Callender, Edward.** A preliminary report on some ice-walled-lake deposits (Pleistocene), Mountrail County, North Dakota, *in* Glacial geology of the Missouri Coteau—Midwest Friends of the Pleistocene, Field Conf. 1967, Guidebook: North Dakota Geol. Survey Misc. Ser. 30, p. 53–62, illus., 1967.

Pleistocene lake-plain sediments from several locations in Mountrail County were investigated in order to interpret their relationship to late Wisconsin ice-stagnation on the Missouri Coteau. A study of the chemical and physical nature of the deposits, the lacustrine environment, and the stagnant-ice terrain indicate that the development of the lake-plain deposits involved initial instability followed by increasing stability within the lacustrine environment. The lakes appear never to have evolved beyond the oligotrophic stage due to changes in physiographic factors.—LLP

Rubin, Meyer. *See* Hanshaw, Bruce B. 01383

01452 **Runcorn, S. K.** Corals and the history of the Earth's rotation: Sea Frontiers, v. 13, no. 1, p. 4–12, 1967.

In this semipopular article, observations by J. W. Wells (1963), C. T. Scrutton (1965), and others on banding thought to represent annual, monthly, and daily growth in Devonian and modern Anthozoa are reviewed. This concept of corals as paleontological clocks is considered in relation to calculation of rate of slowing of Earth's rotation due to tidal friction, and to the problems of the Moon's position

during the first 2.6 billion years of the Earth's existence, and whether the Earth is contracting or expanding.—VMJ

Rush, F. Eugene. *See* Everett, D. E. 01796

01518 **Russell, Ernest E.; Wilson, Charles W., Jr.** Geologic map of the Parsons quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 22-NW, scale 1:24,000, separate text, 1967.

The accompanying text, "Mineral resources summary of the Parsons quadrangle, Tennessee," by C. W. Wilson, Jr. (1967) is cited separately.—MCM

01520 **Russell, Ernest E.** Geologic map of the Stantonville quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 13-NW, scale 1:24,000, separate text, 1967.

The accompanying text, "Mineral resources summary of the Stantonville quadrangle, Tennessee," describes the sand and gravel mined in the area. Deposits of sand and gravel are restricted mostly to the eastern half of the quadrangle; they are dissected remnants of ancient Tennessee River terrace deposits of Pliocene-Pleistocene age, modified by more recent stream activity. Although the deposits are poorly sorted, gravel averages about 3/4 inch and average sand size ranges from 10 to 40 mesh. Large reserves are present and of the 12 pits or mining areas, six were active recently. Potential resources are clay and heavy-mineral sands.—MCM

01570 **Rutherford, G. K.** The micromorphology of some sandy fragipan horizons in soils near Kingston, Ontario: Canadian Geographer, v. 11, no. 1, p. 3–59, illus., tables, 1967.

Fragipan horizons were a marked feature of sandy kame deposits in Little Cataraqui Creek valley, but absent from podzolic soils on the till. The five soil profiles studied are included. Particle size analysis, some analytical data, and results of micromorphometric examinations are tabulated. Although no explanation of the very hard and brittle nature of the sandy horizons could be given, evidence suggested that illuviation processes have brought significant amounts of clay into them from overlying horizons.—ESL

01891 **Saada, Adel S.** Anisotropy and stress reorientation in clay—Discussion [of paper 4903 by J. M. Duncan and H. B. Seed, 1966]: Am. Soc. Civil Engineers Proc., v. 93, paper 5215, Jour. Soil Mechanics and Found. Div., no. SM 3, p. 169–171, 1967.

The use of the terms "deviator," "isotropic," and "anisotropic" are criticized. Two types of anisotropy cannot be postulated because it implies that one can occur without the other. Duncan and Seed (ibid., v. 92, no. SM 5, p. 21–49, 1966) state that the orientation of the failure plane is controlled by the true angle of friction, when in actuality the true angle of friction concept depends on the changes in structure of the material. The use of the accepted methods of analyzing isotropic clays in the analysis of anisotropic clays is difficult to defend because the extension raises unanswerable questions concerning the internal structure of clays.—LLP

11052 **Sackett, William M.; Moore, Willard S.** Isotopic variations of dissolved inorganic carbon: Chem. Geology, v. 1, no. 4, p. 323–328, illus., 1966.

The isotopic composition of the dissolved inorganic carbon in near shore waters varies systematically with chlorinity. Extrapolation to O-chlorinity shows a δC-13 range of -5 to -11 o/oo relative to the Chicago PDB 1 standard for the Hudson and Potomac Rivers and the bayous feeding into Mississippi Sound. The composition of a few samples of open ocean water shows a range of -1 to +2 o/oo. The data suggest that the amount and isotopic composition of the total CO_2 and chlorinity of estuary and coastal waters may be used to characterize and to study the mixing of various water masses, and that it is necessary to re-evaluate paleoenvironmental methods of sediment classification based on the isotopic composition of sedimentary organic and inorganic carbon.—Authors' abstract

Saint-Amand, Pierre. *See* Scholl, David W. 01491

Saint-Amand, Pierre. *See* vonHuene, Roland. 01562

Salkind, Morris. *See* Heyl, George R. 01538

Sandy, John. *See* Hurst, Vernon J. 11089

11079 **Sanford, Thomas H., Jr.** Generalized geologic map of Marshall County, Alabama: Alabama Geol. Survey Map 60, scale about 1 in. to 1 mi., 1966.

01788 **Sargent, Don C.** Jackson Purchase holds oil, gas potential: Oil and Gas Jour., v. 65, no. 28, p. 224–235, illus., 1967.

The Jackson Purchase area, the eastern Gulf Coastal Plain in southwestern Kentucky, is almost totally untested for oil and gas because of difficult drilling and exploration problems. The best potential reservoirs are found in Paleozoic rocks which range in depth from 6,000 to 10,000 feet. The most attractive of these is the biohermal facies of the Kimswick Formation. The younger rocks, which range in age from Cretaceous to Eocene, contain sandstone lenses sufficiently porous and permeable to be reservoir beds in the deeper part of the basin. A serious exploration program should begin with intensive geological study. Using limited subsurface data and some geophysical data, many of the faults could be mapped.—KAD

01702 **Sato, Ryosuke.** Attenuation of the torsional free oscillations in an earth with a dissipative mantle and a dissipative soft-solid core or a viscous-liquid core: Jour. Geophys. Research, v. 72, no. 12, p. 3207–3224, illus., tables, 1967.

The resonance periods and attenuation factors for the torsional free oscillations of the Earth are determined for two cases, a soft-solid core with a dimensionless quality factor Q_c, and a viscous-liquid core with a viscosity v_c. The Gutenberg IV Earth model was adopted.—DBV

Saville, Dudley A. *See* Tek, M. Rasin. 11115

Schaem, William E. *See* Hansen, Wallace R. 11108

Schaffel, Simon. *See* Johnsen, John H. 01555

01473 **Schalscha, E. B.; Appelt, H.; Schatz, Albert.** Chelation as a weathering mechanism—Pt. 1, Effect of complexing agents on the solubilization of iron from minerals and granodiorite: Geochim. et Cosmochim. Acta, v. 31, no. 4, p. 587–596, tables, 1967.

This work is a continuation of previous studies on the role of chelation as a weathering mechanism. Salicylate and several naturally-occurring chelating agents, in the form of free acids or their alkali salts, extracted Fe from goethite, hematite, magnetite, epidote, augite, biotite and granodiorite. The removal of Fe from granodiorite by salicylate was demonstrable within a matter of minutes and continued for 191 hr. K and Al were brought into solution when salicylate reacted with epidote, microcline and granodiorite. Salicylate and 8-hydroxyquinoline extracted Fe from epidote in non-aqueous media. There was no direct correlation between pH and the dissolving action of various reagents. For this and other reasons, the results are interpreted as additional evidence implicating chelation as a weathering process.—Authors' abstract

Scharon, Leroy. *See* Hays, Walter W. 01675

Schatz, Albert. *See* Schalscha, E. B. 01473

11084 **Scheffel, Richard J.** (editor). Geology of New York—A short account: New York State Mus. and Sci. Service Educ. Leaflet 20, 45 p., illus., table, geol. map, 1966.

The leaflet, adapted from the text of *Geologic map of New York State* by Broughton, Fisher, Isachsen, and Rickard, 1962, is accompanied by a physiographic map drawn by J. A. Bier on which a geologic overprint has the original 168 units combined to 16. Pleistocene glaciation and mineral deposits also are reviewed. Both map and text include structure sections.—ESL

Scheidegger, Adrian E. *See* Potter, Paul Edwin. 11063

Schick, Asher P. *See* Wolman, M. Gordon. 01396

01462 **Schlee, John; Cheetham, Alan H.** Rocks of Eocene age on Fippennies Ledge, Gulf of Maine: Geol. Soc. America Bull., v. 78, no. 5, p. 681–684, illus., 1967.

In August 1965, a scallop dredge from R/V Albatross brought up many pieces of fossiliferous opaline chert or porcellanite of Eocene age from Fippennies Ledge, a bank 70 m deep in the central Gulf of Maine. Their presence in this area supports the idea that part of the Gulf is underlain by sedimentary rocks of Tertiary age. Occurrence in the porcellanite of two identifiable species of Bryozoa (ascophoran Cheilostomata), *Kleidionella lobata* Canu and Bassler and "*Ochetosella*" *robusta* Canu and Bassler, suggests (1) correlation with the Castle Hayne Limestone of Claiborne to Jackson age; (2) a temperate zone, distinctly American biogeographic provenance; and (3) accumulation in quiet water.—Authors' abstract

Schmitt, Roman A. *See* Haskin, Larry A. 11057

01749 **Schoen, Robert; White, Donald E.** Hydrothermal alteration of basaltic andesite and other rocks in drill hole GS–6, Steamboat Springs, Nevada, *in* Geological Survey research 1967, Chap. B: U.S. Geol. Survey Prof. Paper 575–B, p. B110–B119, illus., table, 1967.

Geothermal waters produced two recognizable patterns of hydrothermal alteration in the rocks in drill hole GS–6. During an early period, the rocks were subjected to potassium metasomatism that formed K-feldspar and celadonite from unstable feldspars and ferromagnesian minerals, respectively. A later period of hydrogen metasomatism produced mixed-layer illite–montmorillonite, montmorillonite, and kaolinite, probably as a series directly related to the intensity of alteration. The clays formed during hydrogen metasomatism are irregularly distributed with depth and probably are related to reactions involving CO_2 and H_2S. This later period of argillization still may be in progress.—Authors' abstract

01491 **Scholl, David W.; vonHuene, Roland; Saint-Amand, Pierre; Ridlon, James B.** Age and origin of topography beneath Mono Lake, a remnant Pleistocene lake, California: Geol. Soc. America Bull., v. 78, no. 5, p. 583–599, illus., tables, 1967.

Mono Lake is the saline remnant of a much larger late Pleistocene lake. The western lake floor has irregular and relatively steep slopes that flatten below 90 feet. A curved depression borders the southern part of Paoha Island, which is composed of folded and intruded lake deposits of probable late Pleistocene age; a nearly straight depression flanks the island on the east. A well-defined buried acoustic reflector is interpreted as the contact between flocculated water-saturated sediments and semi-consolidated lacustrine deposits of late Pleistocene age. The irregular lake floor and island relief is a result of faulting, gravity slumping, and volcanism that occurred presumably in Recent time. Accumulation of acoustically translucent lake mud is attributed to increase in salinity and decrease in sedimentation rate since the end of Pleistocene time.—JGV

01623 **Schulz, John T., Jr.** Katz–Slick Field, Live Oak County, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 86–90, illus., tables, 1967.

Schürmann, K. *See* Hellner, E. 01653

01672 **Schwarcz, Henry P.** The effect of crystal field stabilization on the distribution of transition metals between metamorphic minerals: Geochim. et Cosmochim. Acta, v. 31, no. 4, p. 503–517, illus., tables, 1967.

The distribution of transition-metal ions between silicate minerals of metamorphic rocks has been analyzed from the standpoint of crystal field theory. It is found that the order of distribution coefficients of ions of the same charge between two phases is partly determined by the relative crystal field stabilization energy (CFSE) of the ions. The effect of ionic radius is estimated to be smaller than that of CFSE. Use of CFSE values may lead to prediction of temperature dependence of trace-element partition coefficients.—Author's abstract

01465 **Schwarz, E. J.; Christie, K. W.** Original remanent magnetization of Ontario potsherds: Jour. Geophys. Research, v. 72, no. 12, p. 3263–3269, illus., table, 1967.

The nature of original remanent magnetization of 18 potsherds dated between 500 B.C. and 1700 A.D. was investigated by comparing its thermal decay with the acquisition of pTRM in the present geomagnetic field. The original remanence of these specimens is complex rather than pure, and stable TRM was acquired during cooling through the Curie point in the contemporary geomagnetic field after the pots were originally fired. A comparison of CRM and pTRM acquired by synthetic Fe_3O_4 with results obtained for the potsherds indicates that most sherds acquired CRM during firing well below the Curie point and pTRM during cooling after original firing. A comparison of the original pTRM component of the sherds with pTRM acquired in the present field suggests a decrease in geomagnetic total force in South-West Ontario during the last two milleniums.—*from* Authors' abstract

01642 **Sclater, John G.; Corry, Charles E.** Heat flow, Hawaiian area: Jour. Geophys. Research, v. 72, no. 14, p. 3711–3715, illus., table, 1967.

Results of 53 measurements of heat flow through the ocean floor around the Hawaiian Islands range from 0.71 to 1.9 μ cal per cm^2 sec. The mean value for all the measurements (including 10 previous measurements) north and east of Oahu, Maui, and Hawaii is 1.38 μ cal per cm^2 sec. Statistical analysis of these values indicates that the mean heat flow southeast of Hawaii, 1.60 μ cal per cm^2 sec, is significantly greater than the mean flow, 1.30 μ cal per cm^2 sec, through the Hawaiian arch. The similarity of all the values to the oceanic average indicates, however, that neither area is thermally active and suggests that the source of the present activity on Hawaii does not extend beyond the island.—DBV

Scott, Ronald F. *See* Ko, Hon-Yim. 01903

Scott, Verne H. *See* Sternberg, Yaron, M. 01868

01884 **Seed, H. Bolton; Wilson, Stanley D.** The Turnagain Heights landslide, Anchorage, Alaska: Am. Soc. Civil Engineers Proc., v. 93, paper 5320, Jour. Soil Mechanics and Found. Div., no. SM 4, p. 325–353, illus., table, 1967.

During the Alaskan earthquake of March 27, 1964, a large landslide, involving a strip of coastline about 8500-feet long and extending inland about 900 feet, occurred in the Turnagain Heights area of Anchorage. Soil conditions in the slide area and the mechanics of landslide development are analyzed. It is concluded that the slide developed as a result of a loss in strength of the soils, particularly lenses of sand, underlying the area as a result of the sequence of earthquake ground motions, and that the mechanics of soil movement in the slide area were complex, involving the subsidence of large blocks of soil, the lateral displacement of clay in a 25-ft thick zone, and the simultaneous lateral translation of the slide debris on liquefied sands and silts.—*from* Authors' abstract

Seed, H. Bolton. *See* Idriss, I. M. 01888

01890 **Seed, H. Bolton.** A method for earthquake resistant design of earth dams Closure [to 1966 discussion by H. R. Cedergren of paper 4616, 1966]: Am. Soc. Civil Engineers Proc., v. 93, paper 5215, Jour. Soil Mechanics and Found. Div., no. SM 3, p. 161–162, 1967.

The author agrees with Cedergren (ibid., v. 92, no. SM 5, p. 140–141, 1966) that information on the true behavior of large earth masses is sparse, but states that progress is being made and many of the questions will be answered. Although

Seed's analysis method (ibid., v. 92, no. SM 1, p. 13–41, 1966) was designed for homogeneous embankments, it can with the aid of recent studies be adapted to studying the stability of saturated portions of composite embankments.—LLP

01892 **Seed, H. Bolton.** Slope stability during earthquakes: Am. Soc. Civil Engineers Proc., v. 93, paper 5319, Jour. Soil Mechanics and Found. Div., no. SM 4, p. 299–323, illus., table, 1967.

Catastrophic slope failures, which have occurred during medium and large earthquakes, illustrate the need for development of reliable methods for anticipating and preventing such failures. The limitations of pseudostatic methods are outlined, and recent developments relating to dynamic response analyses, investigations of soil behavior under cyclic load conditions, design procedures, and analyses of actual slope failures are described. It is suggested that these developments provide a framework for evaluating previous failures and an improved guide to engineering judgment in the evaluation of slope stability during earthquakes.—*from* Author's abstract

01812 **Seeley, H. G.** Dragons of the air—An account of extinct flying reptiles: New York, Dover Publications, 239 p., illus., reprinted 1967; originally published 1901.

This edition is neither abridged nor altered from the original work, but does contain a new introduction by E. H. Colbert. The book includes chapters about flying reptiles and other flying animals, identification by bones and soft parts, plan of the skeleton, evidence of the animal's habits from remains, relations to other animals, origin of the pterodactyls, and classification of the ornithosaurs.—LLP

11107 **Seiglie, George A.; Bermúdez, Pedro J.** Tres géneros nuevos y una especie nueva de foraminíferos del Terciario de las Antillas [with English abs.]: Eclogae Geol. Helvetiae, v. 59, no. 1, p. 431–435, illus., 1966.

Two new genera of Foraminifera are here described from the middle Eocene Vega Grande Formation, type locality, Las Villas Province, Cuba: a miliolid *Longiapertina* (type species, *L. varistriata*, n.sp., here described); a discorbid, *Asterogerinita* (type species, *Globorotalia kochi* Pijpers, 1933). The new rotaliid genus *Reichelinella* (type species, *Discorbis baitoensis* Bermúdez, 1949) is described from the Miocene of the Dominican Republic and of a section near Ubera, Oriente Province, Cuba.—VMJ

01385 **Sellers, Bach; Ziegler, Charles A.; Papadopoulos, John.** Development of a radioisotope gage for monitoring sediment concentration in rivers and streams, *in* Isotope techniques in the hydrologic cycle–Symposium, Univ. Illinois, 1965: Am. Geophys. Union Geophys. Mon. Ser., no. 11, p. 3–10, illus., table, 1967.

A radioisotope gage has been developed that is capable of determining the concentration of suspended sediment in rivers and streams. The gage measures transmission of 22-kev X rays from Cd 109 through the sediment-containing water and compares the results with the transmission through a distilled water sample. Unattended operation over a period of 7 1/2 days is possible, and accuracy is better than ±20 percent for all sediment concentrations in the range 1,000 to 50,000 ppm. The unit has been calibrated and field tested and is presently being delivered for extended evaluation on site.—Authors' abstract

01795 **Shamburger, Victor M., Jr.** Ground-water resources of Mitchell and western Nolan Counties, Texas: Texas Water Devel. Board Rept. 50, 175 p., illus., tables, geol. map, 1967.

Water-bearing rocks containing water of usable quality in Mitchell and western Nolan Counties include Permian beds, Triassic Santa Rosa and Chinle Formations, Cretaceous Trinity and Fredericksburg Groups, Ogallala Formation, and Quaternary alluvium. The principal aquifer is basal gravel and sand of the Santa Rosa and sand of the Trinity. Water of quality usable for municipal and most irrigation and industrial purposes occurs in the Santa Rosa east of Colorado City; however, hardness is very high and fluoride is marginally acceptable to excessive in many places. It is estimated that between 12,000 and 15,000 acre-feet of water

per year can be developed from the Santa Rosa east of the Colorado River on a perennial basis and approximately 2,000,000 acre-feet of usable water is stored in the aquifer.—*from* Author's abstract

01393 **Shamir, Uri Y.; Harleman, Donald R. F.** Numerical solutions for dispersion in porous mediums: Water Resources Research, v. 3, no. 2, p. 557–581, illus., tables, 1967.

A numerical method is presented for the solution of problems of dispersion in steady 3-dimensional potential flow fields in porous mediums, in which the miscible fluids have the same density and viscosity. The method is developed and tested for 2-dimensional problems, and the extension to three dimensions is presented. Emphasis is put on the efficiency of the numerical scheme and on its generality. It is shown to be independent of the geometry of the flow field. The computer program for carrying out the computations as described is tested with simple problems, for which exact or approximate analytical solutions exist. It is also used to obtain solutions to a few problems for which no other solution is known.—Authors' abstract

01756 **Shawe, Fred R.** Geologic map of the Elkton quadrangle, Todd County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-650, scale 1:24,000, section, text, 1967.

Limestone is produced from the Renault Limestone and previously from the Paint Creek and Ste. Genevieve Limestones. There is one abandoned oil field whose producing interval was a short distance beneath the Chattanooga Shale.—MCM

01516 **Shepherd, J. B.; Robson, G. R.** The source of the T phase recorded in the eastern Caribbean on October 24, 1965: Seismol. Soc. America Bull., v. 57, no. 2, p. 227–234, illus., tables, 1967.

A high-frequency disturbance lasting for about 20 minutes was recorded at several seismograph stations in the eastern Caribbean on October 24, 1965. The disturbance was propagated as the T-phase from the submarine volcano "Kick-'em Jenny", possibly generated by collapsing steam bubbles generated during an eruption of the volcano. The total volume of steam required is estimated to be 6×10^{9} cm^{3}. The disturbance was felt at MM intensity III in St. Vincent, 90 km from the source, and at intensity II at a few places in Martinique, 250 km from the source.—DBV

01859 **Sherard, James L.** Earthquake considerations in earth dam design: Am. Soc. Civil Engineers Proc., v. 93, paper 5322, Jour. Soil Mechanics and Found. Div., no. SM 4, p. 377–401, illus., table, 1967.

Conclusions drawn from a two-year study of earth-dam design in regions of earthquake activity are summarized. Design provisions include zoning to resist concentrated leaks, special details at the top of the dam, choice of core material, and evaluation of the seismicity of the site. Earthquake-generated seiches are not considered of sufficient magnitude to endanger the dam.—LLP

Sherman, G. D. *See* Liu, Po-Ling. 11077

Sherman, G. D. *See* Houng, K. H. 11078

Sherman, G. D. *See* Allen, V. T. 11114

Sherman, Larry G. *See* Tek, M. Rasin. 11115

Shields, Clyde E. *See* Jansen, Robert B. 01886

01549 **Shilts, William.** Pleistocene geology of south-central and southwestern Vermont [abs.], *in* New York State Geol. Assoc., Guide book to field trips, 39th Ann. Mtg., New Paltz, N. Y., 1967: New York, City Coll. City Univ. New York, Dept. Geology, p. TK8, 1967.

Shlemon, Roy J. *See* Geological Society of Sacramento. 01866

Shor, George G., Jr. *See* vonHuene, Roland. 01562

01400 **Shuman, Fred Leon, Jr.** A similitude study of soil strength instruments [abs.]: Dissert. Abs., Sec. B., Sci. and Eng., v. 27, no. 9, p. 3081B–3082B, 1967.

11061 **Siegel, Frederic R.; Reams, Max W.** Temperature effect on precipitation of calcium carbonate from calcium bicarbonate solutions and its application to cavern environments: Sedimentology, v. 7, no. 3, p. 241–248, table, 1966.

Filtered solutions prepared from spar calcite, coralline aragonite, or carbonate rocks from karst areas and evaporated under controlled temperature conditions, precipitated 100 percent calcite in the 2–100°C range. With a prepared mixture of 70 percent aragonite and 30 percent calcite, the precipitates were apparently affected by seed nuclei which passed through the filter, varying with temperature. Natural calcium bicarbonate solutions from caves yielded only calcite at 25°C. Since appreciable amounts of aragonite are found in many cave deposits, factors other than temperature must influence the polymorphs of $CaCO_3$ found. If rapid evaporation and slow diffusion of solutions favor aragonite, layers of aragonite and calcite in speleothems may represent alternate wet and dry paleoclimates.—GDC

01600 **Siegel, S. M.; Roberts, Karen; Nathan, Henry; Daly, Olive.** Living relative of the microfossil *Kakabekia*: Science, v. 156, no. 3779, p. 1231–1234, illus., tables, 1967.

A living, ammonia-obligate, umbellate form similar to the Precambrian microfossil *Kakabekia umbellata* (found in the Gunflint range of Ontario) has been isolated from two soil specimens collected at Harlech, Wales. The two soils are similar with respect to high content of C, H, and organic N and low levels of Na, K, and Ti, but quite different in all other constituents. The *Kakabekia*-like forms can be grown in glucose-ammonia mediums, or on peptone and silicate in glucose-free mediums. Ammonia is necessary, and growth is slow without glucose.—DBV

Simmons, Daryl B. *See* Komuro, Saburo. 01869

01506 **Simms, Richard W.** Ramirena Southwest Field, Live Oak County, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 161–165, illus., tables, 1967.

01550 **Simpson, H. James.** Geochemistry of a meromictic lake [abs.], *in* New York State Geol. Assoc., Guide book to field trips, 39th Ann. Mtg., New Paltz, N. Y., 1967: New York, City Coll. City Univ. New York, Dept. Geology, p. TK8–TK9, 1967.

Simpson, Thomas A. *See* Daniel, Thomas W., Jr. 11076

Sippel, R. F. *See* Glover, E. D. 01663

Skinner, E. L. *See* Wiitala, S. W. 01801

Skinner, Roland B. *See* Swingle, George D. 01774

01742 **Sloan, C. E.** Ground-water movement as indicated by plants in the prairie pothole region, *in* Glacial geology of the Missouri Coteau—Midwest Friends of the Pleistocene, Field Conf. 1967, Guidebook: North Dakota Geol. Survey Misc. Ser. 30, p. 95–99, 1967.

Plants indicate the salinity and permanence of water in potholes, variables that are controlled primarily by ground-water flow systems. Thus, plants indirectly indicate the effects of ground-water flow systems on the hydrology of potholes.—Author's summary

01632 **Smiley, Charles J.** Paleoclimatic interpretations of some Mesozoic floral sequences: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 6, pt. 1, p. 849–863, illus., tables, 1967.

Cretaceous floral sequences of Alaska can be referenced to European stages because of interbedded marine invertebrate index fossils. Comparisons of local floral sequences permit regional correlations of nonmarine deposits across northern Alaska. Comparisons with North American and Eurasian Mesozoic floras suggest that vegetational and inferred climatic zonations were latitudinal, and that vegetational zones shifted northward from Early Jurassic to medial Cretaceous (Albian) time, indicating a warming trend, followed by cooler climates in later Mesozoic time. Comparisons of floral records do not favor concepts of wandering poles, drifting continents, or change in axial inclination as causal factors of climatic change since at least the beginning of Jurassic time.—*from* Author's abstract

01420 **Smith, David Lawrence.** First order drainage basin morphology in a portion of the Sierra Nevada, California [abs.]: Dissert. Abs., Sec. B., Sci. and Eng., v. 27, no. 9, p. 3153B–3154B, 1967.

Smith, J. V. *See* Newton, R. C. 01735

01678 **Smith, Peter J.** The intensity of the ancient geomagnetic field: Royal Astron. Soc. Geophys. Jour., v. 12, no. 4, p. 321–362, illus., tables, 1967.

All available determinations of the intensity of past geomagnetic fields are compiled and analyzed. The main conclusions are: (1) rock alteration during heating to induce artificial TRM may be overcome by heating selected naturally highly oxidized specimens in air; (2) effects of secondary components may be avoided by using that part of the primary moment remaining after thermal or a–c cleaning; (3) the geomagnetic dipole is not constant within any given polarity, but fluctuates with a period, possibly of the order of 10^4 yr; (4) due to these fluctuations and nondipole field variations, mean strength of the geomagnetic dipole at any given time cannot be determined from just a few samples; (5) the limited data from the transition zones suggest that during a reversal the dipole moment reduces to zero but the nondipole field remains.—DBV

Smith, Richard H. *See* Haskin, Larry A. 11057

01392 **Smith, W. O.** Infiltration in sands and its relation to groundwater recharge: Water Resources Research, v. 3, no. 2, p. 539–555, illus., 1967.

Several experiments on the mechanics of infiltration with sands involves a drop of liquid falling in a capillary tube. The equations of capillarity are reviewed from a thermodynamic standpoint and are given in both integral and differential form. It is concluded that infiltration is a downward movement of water in bulk form, under ordinary hydraulic laws subject only to the reduced or otherwise altered pressures caused by capillarity within the bulk mass of liquid. Film flow appears to be confined to local flow to contact points, which is compatible with the condition that the free energy of capillary surfaces in a sand must be at a minimum. The results when applied to the infiltration process agree with field data.—*from* Author's abstract

01514 **Sokolowski, T. J.; Miller, G. R.** Automated epicenter locations from a quadripartite array: Seismol. Soc. America Bull., v. 57, no. 2, p. 269–275, illus., 1967.

The quadripartite seismic net on Oahu, Hawaii, can be used for rapid location of an earthquake epicenter, if the earthquake is large enough to be recorded by the array and falls within the P-range. All tsunamigenic earthquakes meet these criteria. Methods are developed here for situations which require a determination of the epicenter within minutes after the earthquake is recorded; a small computer is adequate.—DBV

01525 **Solomonson, D. W.; Kiminsky, P. D.** North Rincon Field, Starr County, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 138–141, illus., tables, 1967.

01620 **Solomonson, D. W.; Kiminsky, P. D.** La Copita Field, Starr County, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 101–105, illus., tables, 1967.

01530 **Sorrell, Ben.** Dubose Field, Gonzales County, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 55–58, illus., tables, 1967.

01829 **Stanley, Daniel J.; Blanchard, Laurie R.** Scanning of long unsplit cores by X-radiography: Deep-Sea Research, v. 14, no. 3, p. 379–380, illus., 1967.

The dominant features of an entire core, even one stored in a metal liner, can be recorded without any reduction on radiographs, which can be stored in a core record library. Several plates showing radiographs of cores accompany the paper.—ESL

01857 **Stanley, Daniel J.** Sediment dispersal and submarine morphology of the Nova Scotian Shelf and Slope—Review of a 5 year study [abs.]: Coastal Research Notes, v. 2, no. 5, p. 9–10, 1967.

01820 **Staples, Lloyd W.** The merits of multiple sites for field camps: Jour. Geol. Education, v. 15, no. 3, p. 113–115, illus., 1967.

The merits of teaching field geology courses from a single site, from multiple sites, or during continuous travel are compared. The multiple-sites method has the advantage that it is an opportunity to gain an understanding of many geologic types without becoming a "sightseeing tour."—LLP

01592 **Steenland, Nelson C.** Aeromagnetic study of Coyanosa: Geophysics, v. 32, no. 2, p. 282–290, illus., 1967.

Results of an aeromagnetic survey of the Coyanosa field in the Delaware basin of Texas are presented and discussed. The final model anomaly has an amplitude of 45γ; when this is subtracted from the original observed field, there remains an anomaly from a probable structure in the east. About 20γ of anomaly can be attributed to additional faulting into the basin along the western side of Coyanosa not represented by the Coyanosa structure.—DBV

01593 **Steenland, Nelson C.** Aeromagnetic evidence for Hueco Mountain wrench fault, Texas: Geophysics, v. 32, no. 2, p. 291–296, illus., 1967.

Aeromagnetic data indicate vertical and horizontal movement along the southern edge of the Hueco Mountains of Texas. The amount of slip is small, but the displacement is of interest because it occurs at the junction of the Basin and Range province and the thrust belt of northern Mexico. Plotting the Hueco fault and its probable continuation on the tectonic map of the United States suggests a major fault system of continental proportions, continuing southeastward between the Diablo platform and the Delaware basin.—DBV

11105 **Stephens, William M.** Floor of the sea: Sea Frontiers, v. 12, no. 4, p. 238–253, illus., 1966.

This semipopular article is based on a chapter from the author's book, "Science beneath the sea," published in 1966 by G. P. Putnam's Sons. Topics discussed briefly include: recent exploration of bottom features such as submarine canyons, abyssal hills, mid-ocean ridges and trenches; sampling of bottom sediments, dating of sediment cores, and seismic methods for measuring thickness of sediments; and history of the Mohole Project.—VMJ

01734 **Sternberg, Richard W.** Recent sediments in Bellingham Bay, Washington: Northwest Sci., v. 41, no. 2, p. 63–79, illus., 1967.

Two rivers, the Nooksack at the north and the Samish at the south, have built relatively large deltas into this bay. The river lowlands are mantled with marine silts and clays, various types of glacial deposits, and alluvium. Most of the Bay sediments can be divided by size into three major types: delta platform sands, bay

muds, and lag gravels covering a shallow sill on the western side. The coarse fraction includes wood and shell fragments, foraminifers tests, clay galls, and terrigenous sand. Sediment distribution and shapes of the deltas are controlled by marine action of wind waves and shapes of the deltas are controlled by marine action of wind waves and tides. The Samish delta is considered dormant; the Nooksack, in the past 70 years, has extended seaward about one mile. Sedimentation in the bay is sporadic.—GDC

01868 **Sternberg, Yaron, M.; Scott, Verne H.** Mutual interference of water wells: Am. Soc. Civil Engineers Proc., v. 93, paper 5346, Jour. Hydraulics Div., no. HY 4, p. 169–181, illus., 1967.

A general equation is developed which describes the relationship between the drawdown of any one well in an array which is pumping at a decreasing rate, the duration of pumping, the distance from the well to the other wells, and the aquifer characteristics for an infinite, homogeneous, confined aquifer. The decrease in discharge is introduced by means of the head–capacity curve for each pump. These relationships can be used to predict future drawdown and discharge for any individual well, existing or proposed, in an array having a given geometrical pattern. An example is provided for the case of three wells located at the vertices of an equilateral triangle. The variation of discharge with time for various well spacings for each of the three wells is presented.—Authors' abstract

01377 **Stewart, Gordon L.** Fractionation of tritium and deuterium in soil water, *in* Isotope techniques in the hydrologic cycle—Symposium, Univ. Illinois, 1965: Am. Geophys. Union Geophys. Mon. Ser., no. 11, p. 159–168, illus., tables, 1967.

Preliminary results of laboratory investigations to determine potential capabilities of hydrogen isotopes in age-dating techniques and as tracers for ground and surface water show that tritium and deuterium interact with clay minerals as water diffuses through Davidson clay. Data suggest that two stages characterize this interaction with clay minerals—a rapid exchange with more labile hydroxyl groups, followed by exchange with other structural hydroxyls—and that the isotopic exchange and fractionation of hydrogen isotopes in the clay–water system may be significant for some age-dating and water-tracing investigations. This isotope effect is not important for many investigations because it is small compared with accuracies required. As the tracer art progresses, it will become possible to apply isotope effect corrections to the data.—*from* Author's abstract

Stewart, Robert E., Jr. *See* McAndrews, John H. 01739

01421 **Stewart, Samuel Woods.** Seismic ray theory applied to refraction survey of the Earth's crust in Missouri [abs.]: Dissert. Abs., Sec. B., Sci. and Eng., v. 27, no. 9, p. 3154B, 1967.

Stone, B. C. *See* Kodama, H. 01673

01904 **Stoneley, R.** City living on a fault: Geog. Mag., v. 40, no. 2, p. 122–127, illus., 1967.

The tragedy of San Francisco's April 1906 earthquake and fire concentrated attention on engineering geology and construction. The sudden movement was a horizontal displacement of 16 or more feet along the San Andreas fault, which extends some 700 miles northwesterly from the Mexican border to northern California. Previous movement is indicated by offset river valleys; simulated studies in progressive creep show a rate of two inches a year. Various theories for the causes of earthquakes and seismic studies there and in Japan are cited, with emphasis on the importance of foreshocks and aftershocks, and the possibility of prediction. The fault system of California constitutes a laboratory where nature provides large-scale experimental evidence.—GDC

01384 **Stout, Glenn E.** (editor). Isotope techniques in the hydrologic cycle Symposium, Univ. Illinois, 1965: Am. Geophys. Union Geophys. Mon. Ser., no. 11, 199 p., illus., tables, 1967.

This is a collection of papers on research and the application of isotopes in hydrology, that were presented at a Symposium on Isotopes in the Hydrological Cycle held at the University of Illinois on November 10–12, 1965, and hosted by the Illinois State Water Survey. In some instances, only summaries are given with references to the original publications. Sixteen of the papers are cited separately.—LLP

Strangway, D. W. *See* Ozima, M. 01487

11065 **Stringfield, V. T.** Artesian water in Tertiary limestone in the Southeastern States: U.S. Geol. Survey Prof. Paper 517, 226 p., illus., tables, 1966.

The Tertiary deposits are 1,600–5,500 feet thick and consist primarily of limestones, dolomite, and marl, with some gypsum and anhydrite. The principal aquifer is about 1,000 feet of limestones of middle Eocene to middle Miocene age, and is the main ground-water source for Florida, southern Georgia, and parts of Alabama and South Carolina. The Tertiary is underlain by igneous and metamorphic rocks and Cretaceous sands and gravels, and overlain by less than 100 feet of Pleistocene and Recent deposits. Water enters the aquifers at relatively high altitudes and moves downgradient through aquifers that act as both conduits and reservoirs. The formations yield water from permeable zones in the limestone and from solution cavities. Recharge and discharge areas are of more importance than geologic structures in controlling the direction of water movement.—LLP

01898 **Strom, N. A.** Alberta's proration plan, *in* Oil fields of Alberta supplement, 1966: Calgary, Alberta, Alberta Soc. Petroleum Geologists, p. 5–7, 1967.

Alberta's new proration plan which is striving for economic conservation, elimination of unnecessary costs, and fair opportunity, has the following primary objectives: (1) allocation among pools, (2) distribution of each pool's allocation among the wells, (3) prevention of waste of oil and gas resources, (4) giving each owner the opportunity to obtain a just share of the oil, (5) encouraging pool recovery efforts, (6) deferring abandonment of wells until all economically recoverable oil is produced, and (7) providing for production of low reserve discoveries that appear to have economically recoverable oil.—LLP

01617 **Stumm, Erwin.** *Planalveolitella*—A new genus of Devonian tabulate corals, with a redescription of *Planalveolites foughti* (Edwards and Haime): Michigan Univ. Mus. Paleontology Contr., v. 21, no. 2, p. 67–72, illus., 1967.

Three species of encrusting [upper Middle] Devonian tabulate corals are similar to the Silurian genus *Planalveolites* but differ in lacking tabulae and mural pores. These species are assigned to the new genus *Planalveolitella*. Two of the species, *P. megastoma* (Winchell) and *P. monroei* (Cleland), were formerly assigned to *Alveolites*. The third species, *P. parasitica*, is new and is the type species.—Author's abstract

01531 **Stumm, Erwin C.** Growth stages in the Middle Devonian rugose coral species *Hexagonaria anna* (Whitfield) from the Traverse Group of Michigan: Michigan Univ. Mus. Paleontology Contr., v. 21, no. 5, p. 105–108, illus., 1967.

Specimens of the rugose coral species *Hexagonaria anna* (Whitfield) from the Bell Shale and the Ferron Point Formation show an interesting series of growth stages beginning with a single protocorallite. Serial sections show the developmental stages and method of budding.—Author's abstract

01606 **Stumm, Erwin C.** Devonian trilobites from northwestern Ohio, northern Michigan, and western New York: Michigan Univ. Mus. Paleontology Contr., v. 21, no. 6, p. 109–122, illus., 1967.

Terataspis grandis (Hall) and *Calymene platys* Green are reported from the Bois Blanc Formation of Michigan. *Dechenella alpenesis* Stumm and *Echinolichas lucasensis* sp. nov. are described from the Silica Shale of northwestern Ohio. Additional material of *Basidechenella lucasensis* Stumm and *Greenops chilmanae* Stumm is described from the same formation. Additional material of *Dechenella*

alpenensis Stumm, *Crassiproetus alpenensis* Stumm, *Mystrocephala rara* (Stumm), and *Greenops aequituberculatus* Stumm is described from the Traverse Group of Michigan. *Mystrocephala gemmaea* (Hall) is redescribed and *Otarion?* sp. is described from the Hamilton Group of New York.—Author's abstract

01615 **Stumm, Erwin C.** Tabulate corals of the Silica Shale (Middle Devonian) of northwestern Ohio and southeastern Michigan: Michigan Univ. Mus. Paleontology Contr., v. 21, no. 4, p. 86–104, illus., 1967.

The Silica Shale of Middle Devonian age, located in northwestern Ohio and southeastern Michigan, contains numerous tabulate corals of which only five species have been described. The present paper redescribes these species and describes a new subspecies of *Favosites*, a new species of *Procteria*, a new species of *Striatopora*, four new species of *Trachypora*, two new species of *Cladopora*, and one new species of *Aulocystis*.—Author's abstract

01867 **Suess, Hans E.; Wänke, Heinrich.** Metamorphosis and equilibrium in chondrites: Jour. Geophys. Research, v. 72, no. 14, p. 3609–3612, tables, 1967.

Metamorphism of chondrites and variations in the iron oxide content of their magnesium minerals are unrelated phenomena. This can be seen from the rare gas content and from a number of petrological observations on chondrites. The terms "equilibrated" and "unequilibrated" chondrites are misleading, unless one wants to refer to conditions of preexisting material from which the chondrites formed.—Authors' abstract

Surdam, Ronald C. *See* Goodwin, Jonathan H. 01584

01552 **Sutherland, Jeffrey C.** Mineral–water equilibrium, Great Lakes–Aluminosilicates [abs.], *in* New York State Geol. Assoc., Guide book to field trips, 39th Ann. Mtg., New Paltz, N. Y., 1967: New York, City Coll. City Univ. New York, Dept. Geology, p. TK10, 1967.

01513 **Sutton, George H.; Mitronovas, Walter; Pomeroy, Paul W.** Short-period seismic energy radiation patterns from underground nuclear explosions and small-magnitude earthquakes: Seismol. Soc. America Bull., v. 57, no. 2, p. 249–267, illus., tables, 1967.

Azimuthal radiation patterns of short-period seismic energy obtained from records of 2 nuclear explosions and 2 earthquakes are used to study the propagation and source characteristics of the Pg and Lg phases in the United States. LRSM stations show as much fluctuation in their total short-period energy as in the maximum amplitudes of Pg and Lg; isoenergy lines unmistakably correlate with major tectonic provinces. The high-frequency/low-frequency energy ratio correlates with tectonic provinces, as does the attenuation of seismic energy. There is no systematic difference between short-period radiation patterns of nuclear explosions and earthquakes.—DBV

Swift, Donald J. P. *See* Whitmore, F. C., Jr. 01477

Swindale, L. D. *See* Liu, Po-Ling. 11077

01762 **Swingle, George D.; Larson, Lawrence T.** Mineral resources summary of the Luttrell quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 11 p., 1967.

This text accompanies Tennessee Div. Geology Geol. Map GM 155-NW by Swingle and others (cited separately). Vast reserves of limestone and dolomite and numerous good quarry sites are present in the Luttrell quadrangle; units of the Conasauga, Knox, and Chickamauga Groups are widely exposed and are suitable for ordinary crushed-stone uses; marble zones of the Chickamauga are a source of high-calcium limestone. Total production from an active marble quarry is unknown, but at present about 2,500 cubic feet of stone is produced each month. Potential resources are shale, clay, chert, and sand and there has been some prospecting for zinc.—MCM

01774 **Swingle, George D.; Palmer, Raleigh A.; Skinner, Roland B.; Hawkins, John O.; McReynolds, Joseph L., Jr.** Geologic map of the Luttrell quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 155-NW, scale 1:24,000, section, separate text, 1967.

The accompanying text, "Mineral resources summary of the Luttrell quadrangle, Tennessee," by Swingle and Larson is cited separately.—MCM

01429 **Symons, D. T. A.** Paleomagnetic evidence on the genesis of the hard hematite ore deposits of the Vermilion Range, Minnesota: Canadian Jour. Earth Sci., v. 4, no. 3, p. 449–460, illus., tables, 1967.

Paleomagnetic measurements using standard methods were made on 55 samples of hard hematite iron ore and associated host rocks that were collected from along the surface exposure, and from underground in the Pioneer Mine at Ely and in the Soudan Mine at Soudan, on the Vermilion Range, Minnesota, U.S.A. The unaltered host rocks have a stable pre-folding remanence of probable Keewatin age, whereas the ore and adjacent altered host rocks have a stable post-folding remanence of possibly Early to Middle Keweenawan age. This result indicates that the ore originated as a post-folding epigenetic deposit.—Author's abstract

01677 **Tan, W. C.; VanLandingham, S. L.** Electron microscopy of biological-like structures in the Orgueil carbonaceous meteorite: Royal Astron. Soc. Geophys. Jour., v. 12, no. 3, p. 237, illus., 1967.

The consistent pattern noted in the ultrastructure of the organized bodies present in Orgueil seems to indicate the presence of an organization system reminiscent of biological structures.—DBV

01724 **Tanner, William F.** Multiple influences on sea-level changes in the Tertiary [abs.], *in* Tertiary sea-level symposium: Coastal Research Notes, v. 2, no. 4, p. 10–11, 1967.

11062 **Tanner, William F.** The surf "break"—Key to paleogeography?: Sedimentology, v. 7, no. 3, p. 203–210, illus., 1966.

Ancient geosynclinal coastal deposits probably represent interior shores of low-to-moderate breaker energy levels, such as the modern Gulf of Mexico. Beach sand size distributions are distinguished by an inflection, where finer sizes are winnowed by the breakers, resulting in a two-segment curve. The Lyons Sandstone, a known Permian beach deposit in Colorado, is one example of very low-energy level, where an added tail of fines produces a three-segment curve with two inflections. The surf break in sand along high-energy beaches cannot be preserved. As an indicator of shoreline position the surf break scores well on ease of recognition, reliability, and probability of preservation. It may be an important key to paleogeography; whether similar kinks in certain river sands are inherited from near-by older beach deposits or formed by stream action is not known.—GDC

01422 **Tappe, John.** The chemistry, petrology, and structure of the Big Timber igneous complex, Crazy Mountains, Montana [abs.]: Dissert. Abs., Sec. B., Sci. and Eng., v. 27, no. 9, p. 3154B–3155B, 1967.

01750 **Taubeneck, William H.** Petrology of Cornucopia tonalite unit, Cornucopia stock, Wallowa Mountains, northeastern Oregon: Geol. Soc. America Spec. Paper 91, 56 p., illus., tables, 1967.

The earliest unit in Cornucopia stock is a concentrically zoned tonalite that grades from a more mafic margin to a more felsic core. Differentiation resulted from fractional crystallization and diffusion in a volatile-rich magma that crystallized inward from the margins. Most accessory minerals and alteration products increase systematically from interior to border rocks. New occurrences of zeolites in granitic rocks are recorded. Heulandite is interstitial, an alteration product of plagioclase, and a vein mineral in microfractures. Chemical data confirm a trondhjemitic differentiation trend. Proportions of almost all major and minor elements increase or decrease from mafic border to felsic core.—*from* Author's abstract

01574 **Taylor, George C., Jr.** Overseas activities of the U.S. Geological Survey in water resources: Water Resources Bull., v. 3, no. 1, p. 21–28, illus., 1967.

During World War II, in addition to reconnaissance studies for strategic mineral resources, some 20 water geologists and engineers from the U.S. Geological Survey were assigned to battalions of the U.S. Armed Forces to locate suitable water supplies for military operations in foreign areas. At the same time Survey groundwater geologists were involved in appraisals of potential sources along the Pan-American Highway in Central America when coastwise shipping was threatened. Since 1940 there have been some 186 long or short-term cooperative technical assignments with governmental organizations in 48 countries including a number in Central America and the Caribbean islands.—GDC

01872 **Tazieff, Haroun.** The menace of extinct volcanoes: Impact of Science on Society, v. 17, no. 2, p. 135–148, illus., 1967.

Volcanoes that have been inactive for a century or a thousand years can still be alive and may have catastrophic results unless a way is found to predict eruptions. Some of the violent eruptions and ignimbrite flows in historic times are described. The observations that enabled prediction of the 1959–60 Kilauea eruption to be so accurate would not apply to the explosive cones of the circum-Pacific belt. In these volcanoes, magma is viscous and originates nearer the surface; gases may accumulate above the magma until they blow up. Changes in the chemistry of the fumaroles might be a clue; the composition can change very rapidly during eruption, and there would seem to be a connection between water and carbon dioxide content and explosive activity. It has been found also that a relationship exists between deep seismic effects, intermediary effects, and eruptions.—ESL

11115 **Tek, M. Rasin; Wilkes, J. O.; Katz, Donald L.; Saville, Dudley A.; Bhalla, Braham D.; Sherman, Larry G.** New concepts in underground storage of natural gas: New York, Am. Gas Assoc., 342 p., illus., tables, 1966.

Project PO-50, "New concepts in underground storage of natural gas," was carried out from 1963 to 1966 at the University of Michigan for the American Gas Association. Gas production has increased greatly since 1949 to a current consumption rate of 15 trillion ft^3/year. Important developments have been the concepts of "overpressuring" and "aquifer storage," and the applications of digital computers. The main areas discussed are: detection and remedy of leaks from storage reservoirs, soil impermeation by grouting, and underground storage in non-porous media.—LLP

Tempelman-Kluit, D. J. *See* Frebold, Hans. 01779

01381 **Thatcher, L. L.** Water tracing in the hydrologic cycle, *in* Isotope techniques in the hydrologic cycle—Symposium, Univ. Illinois, 1965: Am. Geophys. Union Geophys. Mon. Ser., no. 11, p. 97–108, illus., tables, 1967.

Use of tritium, deuterium, oxygen 18, and carbon 14 to represent circulation on the continental and hemispheric scale gives new significance to tracing of water movement through the hydrologic cycle. The traditional concept of tracers as limited tools to obtain data about micro-areas within extensive aquifers is outdated by the newer techniques. Tracers for investigation of the hydrologic cycle are introduced on the grand scale by natural processes and fallout, and data obtained by observing their distributions represent integrations of transport processes over large areas. Radioisotopes have also contributed to investigation of local or micro-aspects of the hydrologic cycle. Radioisotope tracers have been substituted for chemical tracers in groundwater velocity and direction measurements, investigation of stratified flow, directional information from pumping tests, and similar studies.—*from* Author's abstract

01509 **Thompson, Thomas L.** Conodont zonation of lower Osagean rocks (Lower Mississippian) of southwestern Missouri: Missouri Div. Geol. Survey and Water Resources Rept. Inv. 39, 88 p., illus., tables, 1967.

Six selected localities [for which measured sections are given] were sampled, units studied being the Pierson, Reeds Spring, and Elsey Formations, and the basal Burlington Limestone. The recovered conodont fauna contains 24 species of 10 genera, including three new species, and six problematical species of two genera. In addition, 10 genera of bar and bladelike conodonts were recovered but not described or illustrated. Three conodont assemblage zones are established; two are subdivided into two subzones, each characterized by a single representative species. Conodont correlation of lower Osagean rocks indicates that all these formations above the lower Pierson become progressively younger southward and westward.—*from* Author's abstract

01792 **Thomson, Keith Stewart.** Notes on the relationships of the rhipidistian fishes and the ancestry of the tetrapods: Jour. Paleontology, v. 41, no. 3, p. 660–674, illus., 1967.

The problem of relationships of the rhipidistians and the first tetrapod vertebrates is examined in light of most up-to-date information. Detailed investigation of comparative morphology of the rostral region of the Rhipidistia fails to support the hypothesis that the Rhipidistia may be separated into two stocks that have given rise to two separate lineages of modern Amphibia. Relationships of the Rhipidistia are interpreted in terms of their overall organizations, and it is concluded that while the group is generally preadapted for the transition to terrestrial life there is no evidence of direct adaptations that would link them phylogenetically to specific groups of Stegocephalia. Differences between lepospondyl and apsidospondyl Stegocephalia are discussed in terms of possible separate evolution. It is nonetheless emphasized that all Tetrapoda must have arisen from essentially the same rhipidistian stock.—*from* Author's abstract

01726 **Thyssen-Bornemisza, Stephen.** Mit einem Seegravimeter bestimmte Horizontalgradienten: Zeitschr. Geophysik, v. 33, no. 2, p. 143–144, illus., 1967.

The determination of horizontal gravity gradients using a sea gravimeter, in Santa Barbara channel off the California coast, is reported briefly.—DBV

Tianco, Estrella M. *See* Ponnamperuma, F. N. 01743

Tilstra, John R. *See* Lowry, Marlin E. 01781

01450 **Todd, Ruth.** Recent literature on the Foraminifera: Cushman Found. Foram. Research Contr., v. 18, pt. 2, p. 88–98, 1967.

Toksöz, M. Nafi. *See* Chinnery, Michael A. 01515

01449 **Toomey, Donald Francis; Mamet, B.** Annotated bibliography of Paleozoic nonfusulinid Foraminifera, Addendum 4: Cushman Found. Foram. Research Contr., v. 18, pt. 2, p. 55–83, 1967.

This addendum includes 150 annotated references pertaining to Paleozoic nonfusulinid Foraminifera, and can be considered reasonably complete through the year 1965. As in previous bibliographies, the aims are unchanged. An attempt is also made to evaluate the literature to date and possibly delineate trends.—*from* Authors' abstract

01689 **Towe, Kenneth M.; Cifelli, Richard.** Wall ultrastructure in the calcareous Foraminifera—Crystallographic aspects and a model for calcification: Jour. Paleontology, v. 41, no. 3, p. 742–762, illus., 1967.

Species of calcareous Foraminifera representing the various types of test walls were examined in polarized light and in the electron microscope. A model is proposed to explain the various crystallographic structures of the walls, and their modes of formation. The model assumes epitaxial calcification on an active-passive organic matrix resulting in a preferred orientation of crystals. Both radial and granular wall types have preferred crystal orientation, and it would appear relatively easy to derive one from the other. The porcelaneous wall differs radically from the other two types. The porcelaneous Foraminifera form a taxonomic group distinct from

the hyaline forms, but a major taxonomic division of the hyaline Foraminifera into radial and granular seems unsubstantiated.—JFM

Trexler, Keith A. *See* Jeffers, Jo. 01441

11075 **Trowbridge, A. C.** Glacial drift in the "Driftless Area" of northeast Iowa: Iowa Geol. Survey Rept. Inv. 2, 28 p., illus., 1966.

The first known map of the Iowa portion of the Driftless Area was published in 1862 and the boundary still represents the eastern boundary of Kansan drift. In 1886 Chamberlin and Salisbury described a pebbly border east of this line but did not believe it was deposited directly by a glacier. Later authors thought erratics and pebbles might be Kansan. A. J. Williams, in 1914 and 1923, found more than 80 patches of drift in the Driftless Area; 12 are described. Since 1928, Nebraskan drift has been mapped by the Iowa Geological Survey in the subject area, and no driftless area is now recognized. More than 100 occurrences of upland glacial drift are known; 9 more recently studied are described.—ESL

Truesdell, A. H. *See* Christ, C. L. 01660

01596 **Tryggvason, Eysteinn; Qualls, B. R.** Seismic refraction measurements of crustal structure in Oklahoma: Jour. Geophys. Research, v. 72, no. 14, p. 3738–3740, illus., 1967.

Results of a deep seismic profile across Oklahoma approximately fit a crustal model having three laterally homogeneous layers (below a thin low-velocity layer), separated by discontinuities. The M-discontinuity lies at 50.9 km, and the crustal discontinuities at 13.7 and 29.6 km.—DBV

01479 **Turek, A.** Age of sulfide mineralization at Lynn Lake, Manitoba: Canadian Jour. Earth Sci., v. 4, no. 3, p. 572–574, table, 1967.

Sulfides at Lynn Lake occur in a gabbroic plug of the Pre-Sickle Intrusive Group which intrudes the Wasekman Series, the oldest rocks of the area. Two samples from a nickel mine at Lynn Lake were analyzed to determine mineralization age. The K-Ar age of 1,715 m.y. and the Rb-Sr of 1,705 m.y. on biotite from a dike cutting the "A" orebody indicate that mineralization occurred sometime before these dates. However, a clinopyroxene sample from the massive sulfides of the "EL" body gives an age of 2,045 m.y. which is significantly older. Although there are several possibilities for the older date, it is considered here to define the lower limit for the mineralization age and for the age of the plug, that is, mineralization and the intrusion of the plug occurred before 2,045 m.y.—LLP

01885 **Turnbull, Willard J.; Hvorslev, Mikael J.** Special problems in slope stability: Am. Soc. Civil Engineers Proc., v. 93, paper 5328, Jour. Soil Mechanics and Found. Div., no. SM 4, p. 499–529, illus., table, 1967.

Special problems of slope stability include slope and foundation problems. Some of the special problems concern cracking of embankment, collapsible soils, tectonic and large-area mass movements of soils, stabilization of slide areas, and basic assumptions in methods for analyzing slope stability. The finite element method of stress analysis may become a valuable tool for interpreting stress and strain conditions in loaded soil masses. Also, improving correlation of analytic procedure with prototype behavior is discussed.—*from* Authors' abstract

01693 **Turnbull, William D.; Reed, Charles A.** *Pseudochrysochloris*, a specialized burrowing mammal from the early Oligocene of Wyoming: Jour. Paleontology, v. 41, no. 3, p. 623–631, illus., 1967.

Pseudochrysochloris yoderensis, genus and species nov., is a mammal whose ordinal and familial affinities are unknown. The material consists of two left humeri, one nearly complete, from the Yoder Formation, Wyoming, of earliest Oligocene time. The anatomical specializations are numerous and peculiar, closely matched only by those of the Cape golden moles (Chrysochloridae, Insectivora), whose known range is limited to the Quaternary of sub-Saharan Africa. Convergent evolution, not

phylogenetic relationship, is believed to explain the similarities. The burrowing stroke of *P. yoderensis* is analyzed by comparison with those of chrysochlorids and notoryctids, and suggestions are offered as to probable details of some of the forelimb muscles and of the bones of the antibrachium and manus, which parts are as yet unknown.—*from* Authors' abstract

01741 **Tuthill, S. J.** Late Pleistocene Mollusca of the Missouri Coteau district, North Dakota—A note and bibliography, *in* Glacial geology of the Missouri Coteau Midwest Friends of the Pleistocene, Field Conf. 1967, Guidebook: North Dakota Geol. Survey Misc. Ser. 30, p. 73–82, illus., tables, 1967.

Lists of late Pleistocene Mollusca and molluscan fossil sites in the Missouri Coteau district are tabulated. Changes in the population structure of the late Pleistocene Mollusca since 9,000±300 B.P., are believed to have been caused by climatic changes rather than a change in the amount of ground and surface water. Because the melting of the buried ice would not sufficiently increase the ground- and surface-water supply to account for the permanent ponds necessary to explain the dominance of brachiates, changes in the molluscan fauna must have been caused by a change in climatic conditions.—LLP

Twiss, Page C. *See* Brookins, Douglas G. 11102

Uehara, G. *See* Houng, K. H. 11078

U.S. Bur. Commercial Fisheries. *See* U.S. Coast and Geodetic Survey. 01488

01488 **U.S. Coast and Geodetic Survey; U.S. Bur. Commercial Fisheries.** Bathymetric map, Long Island Sound (0808N–53): Washington, D.C., U.S. Coast and Geod. Survey, scale 1:125,000, 1967.

01847 **U.S. Geological Survey.** Engineering geology of the Northeast Corridor, Washington, D.C., to Boston, Massachusetts—Bedrock geology: U.S. Geol. Survey Misc. Geol. Inv. Map I–514–A, 7 sheets, scale 1:250,000, sections, text, 1967.

Prepared at the request of the U.S. Department of Transportation, this three part report (Map I–514) summarizes information on the geology as it would affect construction of a proposed high-speed ground transportation facility between major cities of the Northeast Corridor. Five of the sheets are maps of the bedrock geology which is described in the text on sheet 6. A chart summarizes for the map units their geologic description in terms of equivalent geologic unit, lithology, structure, weathering, and topography; and engineering characteristics in terms of physical properties, evaluation of rock for construction, and hydrologic conditions. Sheet 7 contains an index map with sources of published data; separate sheets list sources of hydrologic data.—MCM

01848 **U.S. Geological Survey.** Engineering geology of the Northeast Corridor, Washington, D.C., to Boston, Massachusetts—Coastal Plain and surficial deposits: U.S. Geol. Survey Misc. Geol. Inv. Map I–514–B, 8 sheets, scale 1:250,000, sections, text, 1967.

This second part of the report for the U.S. Department of Transportation to aid in construction of high-speed ground transportation for the Northeast Corridor summarizes the Coastal Plain and surficial deposits for feasibility studies. Sheets 1–5 are geologic maps of the area with sections; sheet 6 shows selected cross sections through the surficial deposits. General surficial geology is described on sheet 6 which also contains a chart of map units with geologic description in terms of lithology, thickness, alteration, and topography; and engineering characteristics in terms of foundation conditions, excavation characteristics, slope stability, significant hydrologic features, and general hydrologic and water-table conditions. Sheet 8 is a geologic index map with sources of published data; separate sheets list sources of hydrologic data.—MCM

01849 **U.S. Geological Survey; Bromery, R. W.; Joyner, W. B.** Engineering geology of the Northeast Corridor, Washington, D.C., to Boston, Massachusetts—

Earthquake epicenters, geothermal gradients and excavations and borings: U.S. Geol. Survey Misc. Geol. Inv. Map I-514-C, 2 sheets, scale 1:500,000, text, 1967.

Sheet 1 of the third part of the report prepared for the U.S. Department of Transportation shows earthquake epicenters recorded in and near the Northeast Corridor from 1534 to 1965; the area has been subjected to abundant earthquake activity and a continuing history of seismic activity must be planned for in any large-scale engineering efforts. Where Coastal Plain sediments overlie typical basement rocks, the geothermal gradient value for the sediments should be used to determine temperature at their base, and the value for basement rocks should be used to determine increase in temperature from base of sediments to desired depth. Presence of 1,000 feet of Coastal Plain sediments would affect temperatures in basement rock below by only a few degrees. Sheet 2 shows location of excavations and borings that serve as sources of engineering data, and selected references and tunnel data.—MCM

01423 **Uyeno, Thomas Tadashi.** Conodonts of the Waterways Formation (Upper Devonian) of northeastern and central Alberta [abs.]: Dissert. Abs., Sec. B., Sci. and Eng., v. 27, no. 9, p. 3155B, 1967.

VanLandingham, S. L. *See* Tan, W. C. 01677

01899 **Vanoni, Vito A.; Hwang, Li-San.** Relation between bed forms and friction in streams: Am. Soc. Civil Engineers Proc., v. 93, paper 5242, Jour. Hydraulics Div., no. HY 3, p. 121-144, illus., tables, 1967.

Experiments were made in flumes with rippled beds to determine the relation between the friction factor and geometric parameters of the ripples. This objective was achieved with reasonable success for beds with ripples of low steepness by using the product eH as a characteristic roughness length in which H is the mean ripple height and e is the fraction of the bed area occupied by the horizontal projection of the steep lee slopes of the ripples. A less satisfactory relation for the friction factor was obtained when H^2/L was used for the roughness length, in which L is the mean ripple length. Experiments showed that the ripple beds were hydrodynamically rough; the friction factors of stabilized beds and the pressure coefficient over a typical ripple were independent of the Reynolds number and were dependent only on flow depth.—*from* Authors' abstract

01856 **Vedder, J. G.; Gower, H. D.; Clifton, H. E.; Durham, D. L.** Reconnaissance geologic map of the central San Rafael Mountains and vicinity, Santa Barbara County, California: U.S. Geol. Survey Misc. Geol. Inv. Map I-487, scale 1:48,000, sections, 1967.

Veirs, C. E. *See* Feth, J. H. 11066

Verma, Harish. *See* Westermann, G. E. G. 01657

01870 **Viorst, Judith.** The changing earth: New York, Bantam Books, 244 p., illus., tables, 1967.

The book, written for young geologists and laymen, is divided into 18 chapters. The text, accompanied by 37 photographs and 30 drawings, covers the growth and scope of geology, structure of the Earth, minerals, rocks, weathering and soils, gravity, work of streams, ground water, glaciers, wind and deserts, the sea and the shore, volcanism and volcanoes, diastrophism and earthquakes, orogeny, unlocking the past, the eras, and geology and man.—ESL

01639 **Vögtli, Kurt.** D. C. resistivity soundings on Devon Island, N. W. T., Canada [with French and German abs.]: Jour. Glaciology, v. 6, no. 47, p. 635-642, illus., table, 1967.

The thickness and resistivity of Arctic ice were systematically investigated by electrical sounding on the Devon Island ice cap and Sverdrup Glacier. The ice masses were generally homogeneous, and there was a sufficient difference between the resistivities of ice and bedrock to give definitive results; the surface layer differed

very little from the ice mass. Thickness and resistivity data for ice and rock strata at Sverdrup Glacier are tabulated.—VSN

01786 **Vokes, Harold E.** Genera of the Bivalvia—A systematic and bibliographic catalogue: Bulls. Am. Paleontology, v. 51, no. 232, p. 111–394, 1967.

This catalog represents a revision and expansion of a similar listing issued to those scientists engaged in the preparation of the Bivalvia volume of the Treatise on Invertebrate Paleontology. Almost all of the more than 9,000 names on the list have been checked against their original published records, and more than 500 entries have been added from more recently published literature. It is believed that the catalog is reasonably complete up to the year 1960. The Newell arrangement and ordinal names have been adopted to agree with the Treatise, with those in the Cox classification in brackets. Nomenclatorial notes significant in interpreting the entries and special symbols are included.—ESL

vonHuene, Roland. *See* Scholl, David W. 01491

01562 **vonHuene, Roland; Malloy, Richard J.; Shor, George G., Jr.; Saint-Amand, Pierre.** Geologic structures in the aftershock region of the 1964 Alaskan earthquake: Jour. Geophys. Research, v. 72, no. 14, p. 3649–3660, illus., 1967.

Seismic and echo sounder profiles in the aftershock region of the 1964 Alaskan earthquake define a pre-existing zone of discontinuous faults in the area of maximum aftershock strain release. Steep reverse faults and possibly other types of steep faults occur in the zone; surface rupture has probably not been continuous along its full length during any Recent earthquake. The fault zone may represent a narrow area of maximum flexure and uplift in the broader area deformed during the 1964 earthquake. An anticline at the continental margin with local large structural relief was also uplifted during the earthquake.—Authors' abstract

01489 **Vorhis, Robert C.** Hydrologic effects of the earthquake of March 27, 1964 outside Alaska: U.S. Geol. Survey Prof. Paper 544-C, p. C1–C54, illus., tables, 1967.

The Alaskan earthquake of March 27, 1964, had widespread hydrologic effects throughout most of the United States and was registered on water-level recorders in many foreign countries. More than 1,450 water-level recorders scattered throughout the United States registered the earthquake; half were obtained from ground-water observation wells and half at surface-water gaging stations. Most of the fluctuations recorded can be referred to more precisely as seismic seiches; however, a few stations recorded the quake as a minor change in stage. The Alaska earthquake is the first for which widespread surface-water effects are known.—LLP

Waines, Russell H. *See* New York State Geological Assoc. 01448

01602 **Walter, L. S.; Clayton, R. N.** Oxygen isotopes—Experimental vapor fractionation and variations in tektites: Science, v. 156, no. 3780, p. 1357–1358, illus., table, 1967.

High-temperature (about 2,800°C) vapor fractionation of a silicate glass that originally contained 82 percent by weight of SiO_2 resulted in a decrease of the silica content to 45 percent. Oxygen isotope analyses show that the O-18/O-16 ratio increased from 13.80 per mil in the starting material to 14.47 and 15.03 per mil in the residuum. This suggests that bediasites, which also exhibit an increase in this ratio with decreasing content of silica, have been subjected to a process of vapor fractionation.—Authors' abstract

01628 **Walter, Louis S.; Adams, Ernst S.** Vapor pressure of natural tektite melts at high temperatures and its application to aerodynamic analysis: Jour. Geophys. Research, v. 72, no. 14, p. 3717–3728, illus., 1967.

Determination of vapor pressure of tektite melts by the boiling point technique is defended; it literally follows from the thermodynamic definition of vapor pressure. Although the material at the stagnation point has a thermodynamic vapor pressure as determined by the boiling point method, vapor fractionation as the material moves

laterally from this point results in a melt of lower vapor pressure on other portions of the front surface of the ablating tektite body. As the major portion of this surface has this lower vapor pressure, the thermodynamic vapor pressure cannot be applied and an effective vapor pressure must be used. This effective vapor pressure function is not yet known.—DBV

Walton, M. *See* deWaard, D. 01595

01701 **Wangersky, Peter J.** Sodium chloride content and compaction in deep-sea cores: Jour. Geology, v. 75, no. 3, p. 332–335, illus., tables, 1967.

In six out of seven cores investigated, a correlation was found between log percent NaCl and depth in core. The relationship is probably due to compaction of the sediment, resulting in a decrease in the interstitial water content with depth. Use of a simple constant correction factor for transformation of core analyses to a salt-free basis will therefore lead to inaccuracies in the transformed data.—Author's abstract

Wänke, Heinrich. *See* Suess, Hans E. 01867

01748 **Wasserman, Gilbert.** Richmond Tunnel, [Pt.] 3: Staten Island Inst. Arts and Sci. Proc., v. 22, no. 1, p. 14–18, illus., 1967.

Six field trips have been made through the aqueduct tunnel beneath upper New York Bay, connecting Staten Island with Brooklyn. Oriented samples were taken at regular intervals over a five-mile section. The three common facies—Manhattan Schist, Inwood Marble, and Brooklyn Gneiss—were encountered without sharp unconformities. Instrumental surveys while the tunnel is still open and a detailed mock-up to be on exhibit in the museum are suggested. For previous trips, see Staten Island Inst. Arts and Sci. New Bull., v. 13, no. 6, p. 61–62, 1964, and v. 15, no. 3, p. 32–35, 1965.—ESL

Watkins, N. D. *See* Wilson, R. L. 01679

01685 **Weber, Don F.** The East Washington-West Goldsby Osborn trend, McClain County, Oklahoma: Shale Shaker, v. 17, no. 9, p. 175–179, illus., 1967.

Production in this oil and gas pool, on the southwest flank of the Oklahoma City uplift at the eastern edge of the Anadarko basin, is from a sand in the Pennsylvanian Deese Group, herein termed Osborn Sandstone. Older production on the crest of the structure was from Simpson sands. The Osborn sand is a channel-type; three lenses can be distinguished on the trend. The channel was affected by development of a delta and alluvial fans, and movement on a fault it crosses. Cumulative production through 1964 was over one million bbl of oil and 9.4 MCF of gas.—ESL

11116 **Weertman, J.** Sliding of non-temperate glaciers: U.S. Army Materiel Command, Cold Regions Research and Eng. Lab. Research Rept. 216, 4 p., illus., 1966.

It is shown in this paper that if the bottom surface of a nontemperate glacier is at the melting point the glacier normally will slide despite the fact that obstacles in the bed may protrude into cold ice. Only if a rather large temperature gradient exists will sliding be prevented; the temperature gradient of a glacier whose bottom surface is at the melting point is expected to be small. The two main mechanisms leading to the mass flow are enhanced creep flow of ice around irregularities and the classical regelation.—GDC

01630 **Weidick, Anker.** About the use of the expression "Inland Ice": Jour. Glaciology, v. 6, no. 47, p. 763, 1967.

The expressions *Indlandsisen* (Danish), *the Inland Ice* (English), and *l'Indlandsis* (French) have been used as synonymous with "ice sheet" or "ice cover", as well as in a restricted way to mean the Greenland Ice Sheet. It is proposed that in the future the word *Indlandsisen* or its English equivalent be restricted to its original

Danish meaning: the ice sheet of Greenland. The general expression for extensive ice covers elsewhere should be simply "ice sheet" or "ice cover".—VSN

01823 **Wentorf, R. H., Jr.** Modern very-high-pressure research: British Jour. Appl. Physics, v. 18, no. 7, p. 865–882, illus., 1967.

A review is given of most of the recent high-pressure work above about 20,000 atmospheres. The work is divided into the following categories—static pressure generation and measurement, measurement of pressure and temperature, shock wave methods, X-ray studies, phase transformations, spectroscopy, electrical phenomena, diffusion and plastic flow, geological studies, and miscellaneous. A bibliography is included.—*from* Author's abstract

01391 **Wershaw, R. L.; Goldberg, M. C.; Pinckney, D. J.** The determination of the ionization constant of 2,4-D in water: Water Resources Research, v. 3, no. 2, p. 511–516, illus., table, 1967.

Application of the compound 2,4-D (2,4-dichlorophenoxyacetic acid), the most widely used herbicide in the United States, may result in the compounds being carried into nearby waters. Studies by various authors show that 2,4-D degrades within several weeks in soils; it can persist for up to six months or more in natural waters. A value for the ionization constant of 1.169×10^{-3} was calculated when the equivalent conductance at infinite dilution of 2,4-D was computed using the Kohlraush method of independent ion mobilities. These results differ from those of other workers who have computed the equivalent conductance using the equations derived by Fuoss and his co-workers for the conductance of strong electrolytes in polar solvents.—*from* Authors' abstract

01568 **Wescott, Eugene M.** Coastal effects in magnetic and telluric current variations near a complex land, shelving seawater boundary: Jour. Geophys. Research, v. 72, no. 7, p. 1959–1969, illus., table, 1967.

Results are presented of magnetic and telluric current measurements made on both sides of the coast near Barrow, Alaska. Owing to the gradually shelving water depth, and the low (10 ohm-m) resistivity of the land, no magnetic coast effect greater than a few percent was found. At nearly all sites the electrical component is polarized nearly perpendicular to the coast, including a site 3 km offshore; this is in agreement with theoretical predictions for the ocean-land boundary. The frequency response of telluric current variations is relatively low to disturbances of the order of 10-sec period.—DBV

11094 **West, Robert C.; Augelli, John P.** Physical patterns, Chap. 2 *in* Middle America—Its lands and peoples: Englewood Cliffs, N. J., Prentice-Hall, p. 20–60, illus., 1966.

This chapter is largely devoted to a discussion of climates and native animal life but also includes descriptions of the 11 physiographic provinces and related geology of New Mexico, Central America, and the West Indies. These are the Mexican Plateau, Balsas Depression, Southern Highlands, Isthmus of Tehuantepec, Coastal Lowlands, Baja California, Old Antillia, the Antillean Foreland, and volcanic axes of Central America and Lesser Antilles. The geologic hazards of Middle America are frequent earthquakes and volcanic eruptions.—ESL

01657 **Westermann, G. E. G.; Verma, Harish.** The Norian Pine River Bridge Section, British Columbia, and the succession of *Monotis*: Jour. Paleontology, v. 41, no. 3, p. 798–803, illus., 1967.

The important section of the Pardonet Formation [Upper Triassic] is reinvestigated. In spite of structural repetition, the stratigraphy and *Monotis* succession as originally assumed are essentially confirmed and supplemented. *M. subcircularis* Gabb is probably already present in the *M. callazonensis*—*M. jakutica* assemblage. *M. ochotica ochotica* (Keyserling) is redescribed from the *M. subcircularis* beds, the first record for the eastern Pacific realm.—Authors' abstract

01683 **Weyl, Richard.** Krustenbau und sialischer Magmatismus [with English, Russian, and Spanish abs.]: Geol. Rundschau, v. 56, no. 2, p. 369–372, 1967.

The circum-Caribbean area is cited as evidence against the widespread concept that sialic magmas are formed by melting of continental crustal rocks or sediments at mountain roots, before or during orogenic folding. It is shown that in this area, sialic magmatism is independent of orogenesis and independent of the existence of continental crust.—DBV

01578 **Whetten, John T.** Lake Chelan, Washington—Bottom and sub-bottom topography: Limnology and Oceanography, v. 12, no. 2, p. 253–259, illus., table, 1967.

Lake Chelan, a fjordlike lake in north-central Washington, consists of two basins separated by a shallow constriction. The Lucerne Basin, at the upstream end of the lake, is 466 m deep and sediments in it are relatively thin except near the upper end. The Wapato Basin is shallow, but sediments are at least 178 m thick. Both basins probably had a glacial origin; however, they probably were carved by different glaciers of different ages. The thick sediment in Wapato Basin was probably deposited by meltwater from the Chelan glacier (which occupied Lucerne Basin) and the Okanogan glacier, which blocked the downstream end of Wapato Basin.—Author's abstract

White, Donald E. *See* Schoen, Robert. 01749

White, Joe L. *See* Post, Donald F. 01826

01522 **White, Richard D.** Sam Fordyce Field, Hidalgo and Starr Counties, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 166–171, illus., tables, 1967.

01895 **Whitman, Robert V.; Bailey, William A.** Use of computers for slope stability analysis: Am. Soc. Civil Engineers Proc., v. 93, paper 5327, Jour. Soil Mechanics and Found. Div., no. SM 4, p. 475–498, illus., tables, 1967.

The capacity of modern digital computers to do large amounts of simple arithmetic is useful in the analysis of slope stability for three reasons: (1) The geometry and soil properties of the slope can be investigated in detail; (2) many trial failure surfaces can be analyzed; and (3) more accurate methods that satisfy statics can be used. A computer-based method of slices proposed by Morgenstern and Price that fully satisfies statics is analyzed. The range of acceptable solutions can be narrowed, and the errors involved in simpler methods of slices can be assessed. Recommendations are made concerning the use of these methods in practical work, and techniques are described that permit effective use of computers for slope stability analysis.—*from* Authors' abstract

01477 **Whitmore, F. C., Jr.; Emery, K. O.; Cooke, H. B. S.; Swift, Donald J. P.** Elephant teeth from the Atlantic continental shelf: Science, v. 156, no. 3781, p. 1477–1481, illus., tables, 1967.

Teeth of mastodons and mammoths have been recovered by fishermen from at least 40 sites on the continental shelf as deep as 120 meters. Also present are submerged shorelines, peat deposits, lagoonal shells, and relict sands. Evidently elephants and other large mammals ranged this region during the glacial stage of low sea level of the last 25,000 years.—DBV

01443 **Whittington, H. B.; Campbell, K. S. W.** Silicified Silurian trilobites from Maine: Harvard Univ. Mus. Comp. Zoology Bull., v. 135, no. 9, p. 447–483, illus., tables, 1967.

A very well preserved silicified fauna, with growth series, of proetacean trilobites of Middle or Late Silurian age (Wenlock–early Ludlow), is described from blocks of Hardwood Mountain Formation, a slightly metamorphosed silty limestone at Baker Pond, Somerset County, Maine. Proetids and otarionids are dominant; scutelluids, encrinurids, dalmanitids, odontopleurids are also present. Three new genera, *Rhinotarion*, *Fragiscutum*, *Xanionurus*, and seven new species are described. Absence of illaenids, cheirurids, calymenids, and lichids, present in midcontinental Silurian faunas, makes correlation difficult; correlation with the Henryhouse,

Oklahoma, fauna is suggested. Two main phyletic lines within Proetacea are differentiated from Early Ordovician time—a proetid line and a dimeropygid–otarionid line.—VMJ

01534 **Wickens, A. J.; Hodgson, J. H.** Computer re-evaluation of earthquake mechanism solutions, 1922–1962: Dominion Observatory Ottawa Pubs., v. 33, no. 1, 560 p., illus., tables, 1967.

A program for determining the best positions of the P-nodal planes and B axis for any set of observations and defining the possible variations, has been applied to the data on 618 earthquakes; these include all for which solutions have previously been published anywhere in the world and for which data are available, together with data collected for a large number of European earthquakes. Data for an earthquake considered by more than one author are treated separately and then combined to produce a final solution. Of the 618 earthquakes, 70 provide unique solutions in which none of the parameters vary by more than 10 degrees; observations for these are listed, together with the constants of the observing station, theoretical amplitude and polarity for each station reduced to the focal sphere, and a plot of the data and solution on a Byerly projection.—*from* Authors' abstract

01801 **Wiitala, S. W.; Newport, T. G.; Skinner, E. L.** Water resources of the Marquette Iron Range area, Michigan: U.S. Geol. Survey Water-Supply Paper 1842, 142 p., illus., tables, geol. map, 1967.

The development of extensive low-grade-iron reserves in the Marquette Iron Range area will require large quantities of water for processing purposes. Inland lakes and streams are the best surface-water sources, and outwash deposits the best potential ground-water sources. Water supplies seem to be adequate and chemical quality of the water is generally acceptable although suspended sediments may become a problem. Water management considerations include the following: time distribution of available water supplies, distribution of water to points of use, effects of surface-water and ground-water development on each other, and conflicts with competing uses. The interrelationships of surface and ground water and a ground-water budget are discussed.—LLP

Wilkes, J. O. *See* Tek, M. Rasin. 11115

Williams, Peter F. *See* Kelling, Gilbert. 01652

01495 **Wilson, Charles W., Jr.** Geologic map of the Clifton quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 33-NW, scale 1:24,000, separate text, 1967.

The text, "Mineral resources summary of the Clifton quadrangle, Tennessee," describes the chert, limestone, sand and gravel, and millstones that have been mined. Chert, residual material derived from the Mississippian Fort Payne Formation, is granular, siliceous, and locally tripolitic; the finer grained material is used for road surfacing. A bed of chert from which millstones have been obtained is about 15 inches thick. Of the many limestone formations, only the Lego and Laurel, Decatur, and Bob Limestones are suitable for most purposes. The bed of Kentucky Lake and alluvium and older fluvial deposits contain large quantities of sand and gravel. Potential resources are phosphate, oil and gas, cement rock, and tripoli.—MCM

Wilson, Charles W., Jr. *See* Barnes, Robert H. 01496

01508 **Wilson, Charles W., Jr.** Geologic map of the Pope quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 32-SW, scale 1:24,000, separate text, 1967.

The text, "Mineral resources summary of the Pope quadrangle, Tennessee," describes the sand and gravel, chert, limestone, and iron ore mined in the area. Residuum of the Fort Payne Formation consists of beds and blocks of chert one to ten inches thick; chert of the Harriman Formation is bedded and blocky, blocks ranging from two to six inches in thickness. Although there are no presently active quarries, the Decatur, Rockhouse, Lego and Laurel, and Bob Limestones are best sources of general-purpose and agricultural limestone. Brown iron ore was mined extensively before the Civil War, but it was of relatively low grade, had high

phosphorus content, and occurred in spotty deposits. The most important concentrations of iron ore are in the lower few feet of the Fort Payne Formation. Sand and gravel are found in alluvial deposits, but all pits are abandoned. Potential resources are phosphate and tripoli.—MCM

Wilson, Charles W., Jr. *See* Russell, Ernest E. 01518

01566 **Wilson, Charles W., Jr.** Mineral resources summary of the Parsons quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 6 p., tables, 1967.

This summary accompanies Tennessee Div. Geology Geol. Map GM 22–NW by E. E. Russell and C. W. Wilson, Jr. (1967), which is cited separately. Mineral resources previously mined in the Parsons quadrangle are chert and limestone. The seven inactive chert pits are in the Harriman Formation; the chert was used primarily as road metal. Two small limestone quarries have been inactive at least 20 years. The Decatur Limestone and the overlying Rockhouse Limestone Member of the Ross Formation are most acceptable for aggregate, road metal, and agricultural limestone. Potential resources are sand and phosphate.—MCM

01619 **Wilson, D. P.** La Gloria Field, Brooks and Jim Wells Counties, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 106–118, illus., tables, 1967.

Wilson, James Lee. *See* Lochman-Balk, Christina. 01634

01723 **Wilson, John A.** Position of Tertiary shore lines, Texas Coastal Plain [abs.], *in* Tertiary sea-level symposium: Coastal Research Notes, v. 2, no. 4, p. 9, 1967.

01679 **Wilson, R. L.; Watkins, N. D.** Correlation of petrology and natural magnetic polarity in Columbia Plateau basalts: Royal Astron. Soc. Geophys. Jour., v. 12, no. 4, p. 405–424, illus., tables, 1967.

This paper reports clear petrological differences between normally and reversely magnetized lavas from the Columbia Plateau basalts. We conclude that self-reversal of magnetization cannot explain this correlation, but that perhaps a causal connection between polarity of the Earth's magnetic field and oxidation state in lavas is necessary to reconcile all the facts.—Authors' abstract

Wilson, Stanley D. *See* Seed, H. Bolton. 01884

Winder, C. G. *See* Lee, P. J. 01424

01649 **Winters, Harold A.** The extent of the Coteau du Missouri in south-central North Dakota, *in* Glacial geology of the Missouri Coteau—Midwest Friends of the Pleistocene, Field Conf. 1967, Guidebook: North Dakota Geol. Survey Misc. Ser. 30, p. 63–71, illus., 1967.

The various definitions of the areal extent and topography of the Coteau du Missouri in south-central North Dakota are reviewed. Because of the problem of definition, the use of the term "Coteau du Missouri" is sometimes awkward, although the term is well established in literature and current usage.—LLP

Witherspoon, P. A. *See* Javandel, I. 01389

Witherspoon, P. A. *See* Freeze, R. Allan. 01483

01696 **Wolleben, James A.** A cephalopod whorl section gage: Jour. Paleontology, v. 41, no. 3, p. 795, illus., 1967.

A simple, inexpensive contour gage is available, which can accurately and quickly give whorl sections for most cephalopods. The price and manufacturer of the gage are given. The gage can also be used for comparing surface curvature or contour on any set of organic or inorganic objects.—JP

01480 **Wolleben, James Anthony.** Biostratigraphy of the Ojinaga and San Carlos Formations of west Texas and northeastern Chihuahua [abs.]: Dissert. Abs., Sec. B., Sci. and Eng., v. 27, no. 9, p. 3155B, 1967.

01396 **Wolman, M. Gordon; Schick, Asher P.** Effects of construction on fluvial sediment, urban and suburban areas of Maryland: Water Resources Research, v. 3, no. 2, p. 451–464, illus., tables, 1967.

Construction operations near Baltimore, Md., and Washington, D.C., are causing marked increases in erosion and stream sediments; sediment concentrations in construction areas range from 3,000–150,000 ppm, whereas the highest concentration from natural and agricultural erosion is 2,000 ppm. Effects on streams include the development of channel bars, bank erosion, abrasion, increased flooding, alteration of flora and fauna due to blanketing of the bottom and changes in light transmission, and alteration of fish species. These effects also result in property damage, destruction of fish, and loss of esthetic value. Although there is some uncertainty as to the economic evaluations of the problems, sediment yield could be reduced by vegetative traps, reduction of time exposure, and various types of detention structures.—LLP

01536 **Wood, Walter A.** Steele Glacier surge: Am. Alpine Jour., v. 15, no. 2, issue 41, p. 279–281, 1967.

Steele Glacier (formerly Wolf Creek Glacier) in the St. Elias Mts., Yukon, has been photographed and studied for 30 years. During the summer of 1965 the current surge was observed in its early stages. In 1966 the Icefield Ranges Research Project established a field camp at the margin and, by helicopter, determined the velocity of flow to be two feet per hour. There was a downward displacement of the entire glacier surface, near the 8,500-ft level, of 240 feet. The wave of ice left remnants high along the marginal slopes and moved the protruding head of a tributary glacier three miles downstream. By September 1966 the surging ice had reached a point only three miles above the moraine built by the last major advance 100 years ago.—ESL

01783 **Woodley, Richard A.; Moore, Samuel L.** Pollution control in mining and processing of Indiana coal: Water Pollution Control Federation Jour., v. 39, no. 1, p. 41–49, illus., table, 1967.

Mining of coal began early in Indiana; commercial mining started in 1812, but not until 1900 was large-scale mining possible. As early as 1925 the problem of mine drainage pollution was observed and operators began flooding final surface-mine excavations and reforesting. The extent of the problem today is shown on graphs. Control of mine drainage from surface mines should start with diversion of surface streams around the recovery area before any overburden is removed, any water infiltrating the excavation should be removed as fast as possible, and acid-producing material encountered should be buried. After completion, excavations should either be flooded, or acid-producing material covered and the excavation kept drained. The underground-mine drainage problem in Indiana consists of seepage from active mines and is controlled by rapid removal of water.—ESL

Woollard, G. P. *See* Malahoff, Alexander, 11072

01621 **Worley, John C.** Las Ovejas Field, Zapata County, Texas, *in* Typical oil and gas fields of south Texas: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 96–100, illus., tables, 1967.

Wormington, H. M. *See* Rogers, Malcolm J. 11093

01560 **Wornardt, Walter W., Jr.** Miocene and Pliocene marine diatoms from California: California Acad. Sci. Occasional Paper 63, 108 p., illus., 1967.

Stratigraphic distribution of diatoms in the upper member of the typical Monterey Formation and the Sisquoc Formation is recorded and analyzed. About 160 species and varieties are systematically described. Two diatom floras, containing both planktonic and benthonic forms, are recognized. The Monterey flora (late Miocene)

and the Sisquoc flora (early or middle Pliocene) are found in superpositional relationship near Lompoc, Calif. On the basis of their demonstrated stratigraphic relationships, and their recognition at other localities widely distributed in the Miocene and Pliocene strata of the Pacific coast, the diatoms appear to be useful for correlating strata throughout the Coast Range area.—*from* Author's abstract

Wosinski, John F. *See* Clarke, Roy S., Jr. 01670

01751 **Wright, W. F.** Potential West Texas giant ignored?: Oil and Gas Jour., v. 65, no. 25, p. 176–178, 1967.

Are large shallow oil fields being overlooked in the Permian Capitan reef in West Texas and southeast New Mexico? The reef has not been adequately explored on a regional basis, considering that reef production must be more stratigraphically than structurally controlled.—KAD

01805 **Young, George A.** A study of the mechanics of slide dams with sand models: Sandia Corp. Labs., Albuquerque, N. Mex., Rept. SC-RR-67-24, 108 p., illus., tables, 1967.

The construction of earth- and rock-filled dams by initiating slides with buried nuclear explosives was the project for the experiments. Two idealized models were used: a plane motion model which simulated a deep, narrow valley when slides are initiated high on each wall, and a three-dimensional model which simulated conditions in valleys with more typical slopes. Variables considered in the first model were volume of slide material, width of slide, height of fall, and physical properties of slide material; in the second, the angle of slope was considered also. Width of slide was found to be one of the most important variables, and particle size was significant. Revetments were not found to be effective. Confidence is expressed that a model study will reveal the crater configuration required to produce the most favorable dam geometry.—ESL

01426 **Young, Grant M.** Possible organic structures in Early Proterozoic (Huronian) rocks of Ontario: Canadian Jour. Earth Sci., v. 4, no. 3, p. 565–568, illus., 1967.

Structures of possible organic origin in Huronian rocks occur in a cliff at the east end of Washagami Lake, in an outcrop near Flack Lake, and in a roadcut southeast of Flack Lake. The Washagami variety has the form of fine laminations of alternating concentrations of chlorite-rich and quartz-rich layers. In some places, they appear to 'grow' around argillite fragments, and some have a finely 'ribbed' upper surface. The variety near Flack Lake are elongate, slightly flattened tubes or cylinders filled with fine-grained quartz sandstone. An organic origin is supported by: presence of longitudinal medial tubes or ridges, overlapping of some structures, and circular or elliptical cross-sections of many structures.—LLP

Young, Keith. *See* Corpus Christi Geological Society. 11067

01831 **Zernetsky, V. F.; Melnik, V. I.** Bottom sediments of the Caribbean Sea and Mexican Gulf [abs.]: Coastal Research Notes, v. 2, no. 5, p. 12–13, 1967.

Ziegler, Charles A. *See* Sellers, Bach. 01385

01777 **Zimmerman, Everett A.** Water resources of the Cut Bank area, Glacier and Toole Counties, Montana: Montana Bur. Mines and Geology Bull. 60, 37 p., illus., tables, geol. map, 1967.

The Cut Bank area is underlain by Precambrian to Recent sedimentary rocks. The Mississippian Madison Group, deeply buried and containing saline water, supplies most of water used for secondary recovery of oil; wells yielding 500 gpm with pumping lifts exceeding 1,000 feet can be obtained. The outcropping Cretaceous Virgelle Sandstone and Two Medicine Formation form the principal source of fresh water for domestic, stock, and industrial use; the Virgelle can yield 250 gpm, the Two Medicine 10 gpm or less; in places both formations are hydraulically connected. Infiltration of precipitation along the outcrop and interformational leakage are major means of recharge. Ground water is commonly mineralized; quality is poorer

at increasing distance from the outcrop as the formations become more deeply buried.—*from* Author's abstract

01433 **Zoltai, S. C.** Glacial features of the north-central Lake Superior region, Ontario: Canadian Jour. Earth Sci., v. 4, no. 3, p. 515–528, illus., tables, 1967.

The surficial glacial features and glacial events of a 13,000 sq mi area in northern Ontario are described, based on field work and study of aerial photographs. Ice-laid and glaciolacustrine materials suggest a complex history of stationary ice fronts and glacial lakes during deglaciation. Lakes in the Lake Nipigon and Lake Superior basins inundated large areas. The northern part of the post-Minong lake was later separated by differential uplift and was named Lake Nakina. After the withdrawal of the ice, Glacial Lake Barlow-Ojibway occupied the northeastern part of the area, and much of it was later overridden by the last glacial readvance. Stratigraphic correlations with radiocarbon dates suggest that the Nakina moraine was built some 9,400 years ago, and that the last glacier ice disappeared before 6,390 years ago.—*from* Author's abstract

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